

WESTERN ATLANTIC BATRACHOIDID FISHES OF THE GENUS *PORICHTHYS*, INCLUDING THREE NEW SPECIES

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ABSTRACT

The batrachoidid fishes of the genus *Porichthys*, commonly called midshipmen, comprise a group of bottom-inhabiting forms that are confined to relatively shallow, continental waters on both coasts of the Americas. They are one of the few groups of fishes living in shallow water to possess photophores, and are unique in this respect among teleosts occurring in the New World. The present study reviews the western Atlantic members of the genus, and concludes that five species occur in the area, of which three are described as new.

INTRODUCTION

The batrachoidid fishes of the genus *Porichthys*, commonly called midshipmen, are confined to relatively shallow, tropical to temperate waters on both coasts of the Americas. They are continental in distribution, as evidenced by the fact that there are no records beyond the limits of the continental shelf, at least for the western Atlantic species (Fig. 5). The greatest confirmed depth from which a specimen has been recorded is 200 fathoms (Fitch, 1964: 28), with most records coming from above 50 fathoms.

The genus *Porichthys* is unusual in that it is one of the few groups of fishes living in shallow water to possess photophores, and is unique in this respect among fishes from the Western Hemisphere. Bioluminescence in this genus is known to be under hormonal control (Harvey, 1952: 538). The rows of photophores are largely concentrated on the underside of the head and body, where they form characteristic patterns (Fig. 1) that have been likened to the rows of gold buttons on a midshipman's uniform. Springer (1957) hypothesized that the similarity in photophore pattern between the midshipmen and the ctenophores (comb jellies) may be an example of evolutionary mimicry, but did not speculate as to its possible significance. Crane (1965) has shown that bioluminescence plays an important role in courtship behavior in *Porichthys notatus*.

Fitch (*in litt.*) has recently found *Porichthys* otoliths in Miocene deposits from western Florida. Inasmuch as otoliths of this genus have never been recorded from the Miocene of California (despite an abundance of fish material of this age), but are common in almost all marine Pliocene and Pleistocene deposits from that area, Fitch hypothesizes an Atlantic origin for the genus *Porichthys*.

Despite the above, only two of the eight currently recognized species of *Porichthys*¹ are found in the western Atlantic: *P. porosissimus* (Valenciennes), which occurs from Virginia to Argentina; and *P. pauciradiatus* Caldwell & Caldwell, known from Costa Rica to Brazil. Three additional western Atlantic species are described in this paper, thus bringing the overall number of species to eleven.

Porichthys porosissimus is an extremely variable species, particularly with regard to color pattern. Variation also exists in fin-ray, vertebral, and photophore counts, as well as in maximum body size, although in no case is this as pronounced as for color pattern. The proper taxonomic placement of the populations comprising this species (*sensu lato*) is subject to varying interpretations, and could result in recognition of from one species, with no noteworthy subunits, to as many as three species and four forms. I conclude that two forms should be recognized: *P. porosissimus* and a new species described elsewhere in this paper.

A number of characters have proved valuable in the identification and phylogeny of the species of *Porichthys*. The most important of these are color pattern; numbers of dorsal, anal, and pectoral-fin rays; number of gill rakers; number of vertebrae; numbers of photophores; form of the branchiostegal photophore series; morphology of the opercular spine; nature of the teeth; and relationship of the dorsal and anal fins to the caudal. In addition, the otoliths, which have proved to be extremely important in fish classification, particularly at the supraspecific level, have been shown to be of value in determining the relationships of the various species of *Porichthys*.

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¹ The nominal genus *Nautopaedium* is regarded here as a synonym of *Porichthys*.

Gulf of Mexico; Madame Marie-Louise Bauchot, Museum National d'Histoire Naturelle (Paris), for information on the types of *Batrachus porosissimus*; Dr. William D. Anderson, Jr., University of Chattanooga (formerly of the University of Florida), for reviewing this manuscript; Mr. Richard B. Roe, United States Fish and Wildlife Service, Pascagoula, Mississippi, for help in determining the collection locality for the paratype of *Porichthys oculo frenum*; Mr. Herbert Gordy, Biological Laboratory, United States Fish and Wildlife Service, Brunswick, Georgia, who took the radiographs used in this study; Mrs. Mildred Eaddy, Florida State Plant Board, Gainesville, who is responsible for the photographs; and Mr. Paul Laessle, who executed the drawings. I also wish to thank those individuals in charge of the collections from which specimens were examined for making this material available.

MATERIALS AND METHODS

Most counts and measurements were made according to the standard methods described by Hubbs & Lagler (1958: 19-26). Measurements are expressed in hundredths of standard length (shortened hereafter to SL); they were taken with precision dividers and were read to the nearest tenth millimeter. The opercular spine was measured along the dorsal surface, from the apex formed by the anterior upward projection posteriorly to the tip. Proportional measurements emanating from the tip of the head and which were measured dorsally (snout length, head length, and predorsal length), were taken from the tip of the snout; those measurements taken ventrally (prepelvic length, preanal length, and lower jaw length) were measured from the tip of the lower jaw. Inasmuch as body length was measured from the tip of the lower jaw (mouth closed) to the hypural plate, one must add a correction factor of about 1 per cent to the values of the first three measurements listed above, in order to correlate them exactly with the other measurements.

The various counts and measurements of *Porichthys porosissimus* were analyzed for the following geographic areas: (1) extreme eastern Gulf of Mexico (from Cedar Keys, Florida, southward), and Atlantic coast of United States, excluding the Florida Keys; (2) Florida Keys, including the Dry Tortugas; (3) Gulf of Campeche and Campeche Banks (Mexico); (4) Gulf of Mexico, excluding those areas listed above; (5) Caribbean Sea, including collections from around Trinidad; (6) coast of South America, from the Guianas to just south of the mouth of the Amazon River; and (7) southern Brazil and Uruguay, from Rio de Janeiro southward. The first three areas above were analyzed separately because individuals from there are much lighter and more heavily spotted than those from elsewhere throughout the range. Specimens from the Florida Keys were separated to determine what effect a presumably warmer environmental

temperature during embryonic development might have on the various meristic features. The other areas were separated according to geographical convenience. In addition, counts and measurements for an atypical population of *P. porosissimus* living in somewhat deeper waters of the southwestern Caribbean were analyzed separately, and were not included in the combined data for this species.

Although the range of *Porichthys porosissimus* is indicated as being continuous in both the species account and on the distribution map (Fig. 5), specimens were not equally available from all areas (e.g., the extreme northeastern Gulf of Mexico, the Caribbean coast of Central America from Nicaragua to the Yucatan Peninsula, and certain areas along the coast of southeastern Brazil). The paucity of specimens from the first two areas appears to be due primarily to unfavorable trawling conditions, whereas for the last it probably is the result of poor representation in United States museums. The few specimens that are available from the above areas do not appear to be atypical.

To avoid sampling bias, no more than ten specimens were counted or measured from a single series, and, in most cases, fewer individuals were analyzed. The only exception was one series of *P. bathoiketes*, in which twelve specimens were counted and measured.

A majority of the proportional measurements for *Porichthys porosissimus* were made on specimens less than 125 mm SL. This was due primarily to the fact that none of the other western Atlantic midshipmen apparently exceeds 103 mm SL, and thus only by measuring the smaller specimens of *P. porosissimus* could an accurate comparison of body proportions be obtained for the five species. Measurements of *P. porosissimus* were separated geographically only for specimens in the 65-127-mm size range. Inasmuch as none of the measurements seem to differ among the various populations (Table 12), data for specimens in the larger size ranges were combined, regardless of geography. In order to determine the changes in body proportions resulting from allometry, specimens of *P. porosissimus* were divided into four size groups: 65-127 mm, 157-170 mm, 185-218 mm, and 270-315 mm SL. Specimens of intervening sizes were not included in the analyses, in order that the allometric changes could be better observed. In the case of the last two size groups, this was also dictated by the fact that no specimens between 218 and 270 mm were available for study.

No attempts were made to sex those specimens from which meristic data were taken. Although it is possible that differences do exist for certain characters, it is felt that failure to separate the data according to sex would in no way alter the present taxonomic conclusions.

Otoliths were examined from four species of *Porichthys* (*P. porosissimus*, *P. notatus*, *P. analis*, and *P. myriaster*) (Fig. 2, a-d). Inasmuch as this

structure may undergo some morphological change with an increase in body length, it is important that the specimens from which otoliths are examined be of comparable size. Although body lengths, unfortunately, were not recorded for any of the above fish, the last three species, judging from the sizes of the otoliths, were similar in size and all were slightly larger than the specimen of *P. porosissimus*. However, since the otoliths from smaller *P. porosissimus* do not appear to differ trenchantly from the one illustrated (Fig. 2, a), it is doubtful that any radical morphological differences would be noted in otoliths of slightly larger size.

All gill rakers in the outer arch were counted, including rudiments. Photophores were counted on one side of the body only; thus, the total number of photophores in a series actually is approximately twice the number listed. This concept is of particular importance in counting the mandibular, branchiostegal, and ventral photophores, since these series are continuous from one side of the body to the other (Fig. 1). For these series, counts were made from the anterior apex to the posteriormost pore. The anal photophore series contains a double row of pores for most of its length. Only the outer pores were counted in the area concerned (Fig. 1). The caudal fin-ray count is written so as to indicate both total elements and number of main (long) caudal rays emanating from the superior and inferior hypurals. Thus, a count of $6 + 7 = 13$ indicates six dorsal and seven ventral main caudal rays. A frequency distribution expressed as "(31) 33 to 36 (37)" indicates that 90 per cent of the counts fall between 33 and 36, with the extremes being 31 and 37; a distribution expressed as "(34) 35 or 36 (37), usually 36," shows that 10 per cent or less of the counts number 34 or 37, and, while a count of 35 is not particularly rare (more than 10 per cent), 36 is a much more common value.

Vertebral counts were determined from radiographs. All were made with type M film and a "hard ray" machine (Miller, 1957).

Specimens examined are separated by major localities under the account of each species. The catalog number is followed, in parentheses, by the number of specimens examined, and, in many cases, their range in standard length. In cases where numerous specimens were available from a limited geographic area, the locality data are partially combined, with the extremes of the geographic range listed for the included specimens; the depth of collection, however, has been recorded individually when this information was available.

Only primary synonymies are listed in the accounts of the genus and species; however, the reader is referred to the paper by Hubbs & Schultz (1939) for a more complete list of synonymies.

Characters mentioned in the diagnosis and description of the genus *Porichthys*, or in the diagnoses of the individual species, are not repeated in the species descriptions, except where greater clarification is required.

Specimens were examined from the following museum collections: Academy of Natural Sciences of Philadelphia (ANSP); Field Museum of Natural History (formerly Chicago Natural History Museum) (FMNH); University of Florida (Florida State Museum) (UF); Florida State University (FSU); Florida State Board of Conservation, St. Petersburg (FSBC); Los Angeles County Museum (LACM); Tulane University (TU); Museum of Comparative Zoology, Harvard University (MCZ); University of Puerto Rico, Institute of Marine Biology (UPR); University of Miami, Institute of Marine Sciences (UMML); Tropical Atlantic Biological Laboratory, United States Fish and Wildlife Service, Miami, Florida (formerly Biological Laboratory, U. S. Fish and Wildlife Service, Brunswick, Georgia [BLBG]) (TABL); and United States National Museum (USNM).

Genus *Porichthys* Girard

Porichthys Girard, 1855: 141 (type-species *Porichthys notatus*, by subsequent designation of Jordan & Gilbert, 1883).

Nautopaedium Jordan, 1919: 342 (type-species *Batrachus porosissimus*, by monotypy.)

Diagnosis.—Batrachoidid fishes characterized by the following features: Two dorsal spines (with no poison sacs at their bases) and a single, strong opercular spine, all without grooves; pectoral axillary gland absent; discrete glands present between bases of uppermost pectoral-fin rays; suboperculum poorly developed, without a spine; some of the teeth canine-like; body scaleless; four lateral lines; photophores present on head and body, these arranged in numerous rows that usually follow the courses of the lateral lines.

Description.—Body rather elongate, tapering, and compressed posteriorly; head depressed, two-thirds as broad as long, the lower jaw projecting considerably; maxillary extending beyond eye, its length going about twice in head; premaxillaries non-protractile; frontal region depressed, forming a triangular area below level of temporal region, its median ridges very low; orbit small, its greatest horizontal diameter going about seven times in head; bony interorbital narrow, with shallow grooves; a deeply crescentic-shaped, pale, translucent area below eye; below translucent area a larger blue-black area, broadly semicircular in shape, covering the preorbital and suborbital regions, bounded below and behind by a row of mucal pores; gill opening extending from upper edge of pectorals obliquely downward to below and just behind insertion of pelvic fin; no frenum connecting gill membranes; branchiostegals six in number; soft dorsal fin long and low, extending from midway above pectoral base to base of caudal fin, and usually not adnate to caudal fin (adnate only in *P. greeni*); anal fin long and low, without spines, commencing beneath second or third dorsal ray and extending posteriorly to caudal fin; anal fin usually not adnate to caudal

fin (adnate only in *P. greenei*); pectoral fin broad, usually bluntly pointed (rounded only in *P. greenei*), and relatively long, extending posteriorly to from sixth to eighth dorsal soft ray; dorsal soft rays 29 to 39; anal rays 27 to 37; pectoral rays 14 to 20; pelvic rays I, 2; total caudal elements 15; principal (long) caudal rays $6 + 7 = 13$; total vertebrae 39 to 46 (no data on eastern Pacific species); four lateral lines on side of head and body, these usually with cirri (cirri absent only in *P. greenei*); apex of branchiostegal photophore series either joined in a broad V (Fig. 1, b), with a U-shaped, forward-directed commissure (Fig. 1, a), or with a short, median, forward-directed branch (in *P. greenei* only); minute photophores usually present around pores of dorsal branch of lateral line (absent only in *P. greenei*); teeth in single row on vomer, palatines, and premaxillary, and on all but anterior part of dentaries, where they are in two rows; teeth on dentaries large (except for inner row near front of bone), strongly hooked inward; lateral teeth hooked either forward or backward and inward; a smaller supplementary canine tooth (adjoining main canine) often present in upper jaw, varying considerably in size from individual to individual or even in the same individual; usually four or five large teeth on palatines, these often interspersed with an equal or greater number of small teeth; peritoneum black; air bladder more or less deeply divided into two lateral parts; no pyloric caeca.

Relationships.—The genus *Porichthys* is most closely related to the monotypic genus *Aphos*, which is known only from the southeastern Pacific, and which, unlike *Porichthys*, lacks photophores on the body.

Collette (1966: 848, fig. 1) has pointed out that *Porichthys*, *Aphos*, *Batrachoides*, and *Daector* differ from other batrachoidid genera in lacking an axillary gland at the pectoral base and in having discrete glands between the bases of the uppermost pectoral-fin rays. In other respects, however, *Daector* appears to be very closely related to the genus *Thalassophryne*, which lacks both axillary and discrete pectoral-fin glands. This would seem to indicate that the axillary gland is a more likely indicator of interspecific relationships. If true, the above five genera, together with *Amphichthys* and *Halophryne*, comprise one species group; and the genera *Batrachomoeus*, *Sanopus*, and *Opsanus* (all of which lack an axillary gland) comprise a second.

Although Hubbs & Schultz (1939: 489) placed the species *porosissimus* in the monotypic genus *Nautopaedium* Jordan, most ichthyologists have not considered the unique character of the forwardly directed palatine and premaxillary teeth to be sufficient for generic recognition. Hubbs & Schultz (1939: 489), themselves, stated, "we do not regard [the genus] as very trenchantly distinct."

Until now, the decision whether or not to recognize *Nautopaedium* has rested largely on subjective grounds. Caldwell & Caldwell (1963: 7), in

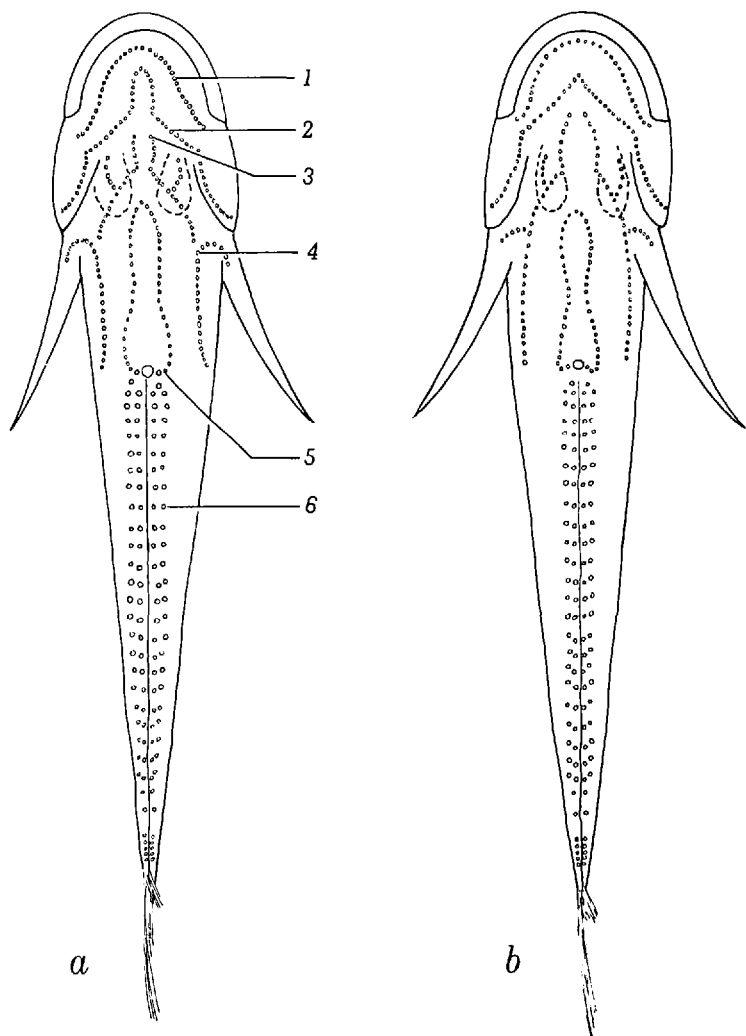


FIGURE 1. Illustrations of the various photophore series in species of *Porichthys* on which counts were made. The pattern for the branchiostegal series (2) seen in the left drawing (a) is found in *P. porosissimus* and *P. bathoiketes*; the pattern for this series in the right drawing (b) is found in the remaining western Atlantic species. Photophore series: 1, mandibular; 2, branchiostegal; 3, gular; 4, gastric; 5, ventral; 6, anal.

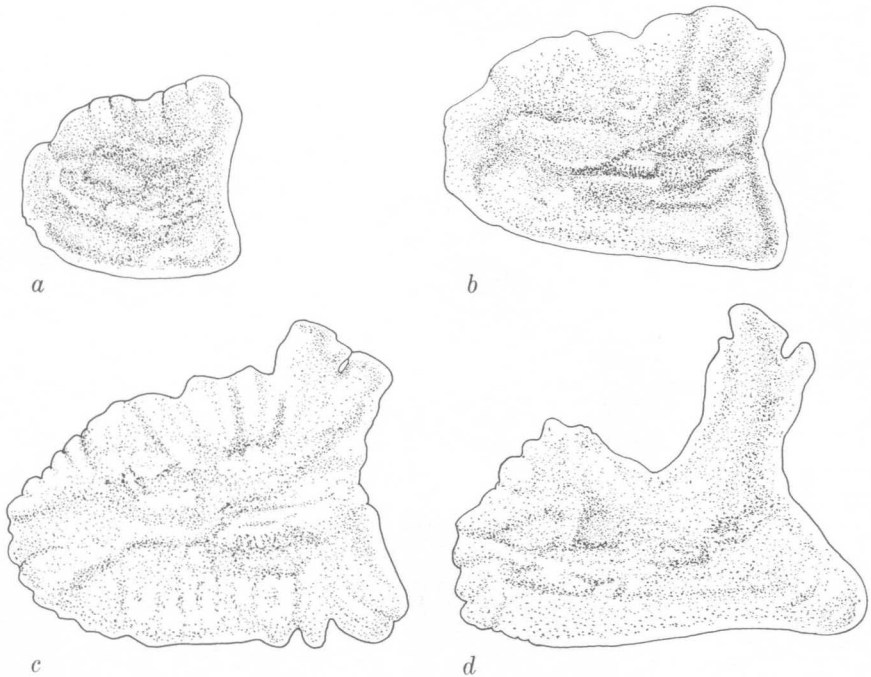


FIGURE 2. Otoliths of four species of *Porichthys*. Drawings are of left sagitta, inner face. All are enlarged 12 times. a, *P. porosissimus*; b, *P. notatus*; c, *P. analis*; d, *P. myriaster*.

questioning its validity, noted that in small specimens of *porosissimus* the teeth are directed backward, as in other species of midshipmen. Lane (*in litt.*) says, "I find that [the presence of forwardly-directed premaxillary teeth in the male] is only a 75% character, and that some large males don't develop the large teeth, while some females do." Examination of the otoliths in four species of *Porichthys* (*porosissimus*, *notatus*, *analis*, and *myriaster*, Fig. 2, a-d) shows that this structure is rather similar in *porosissimus* and *notatus*, whereas the otolith of *P. myriaster* is very different from both. The otolith of *P. analis*, although more similar to those of *P. porosissimus* and *P. notatus*, seems to share certain features with *P. myriaster*. Since otoliths have been shown to be important taxonomic characters, particularly at the supraspecific level, it would appear that the species *porosissimus* and *notatus* are fairly closely related, and that there is no valid reason for recognizing *Nautopaedium* as a distinct genus. If so, *Nautopaedium* is not usable, even as a subgeneric name, since *P. notatus* is the generic type of *Porichthys*.

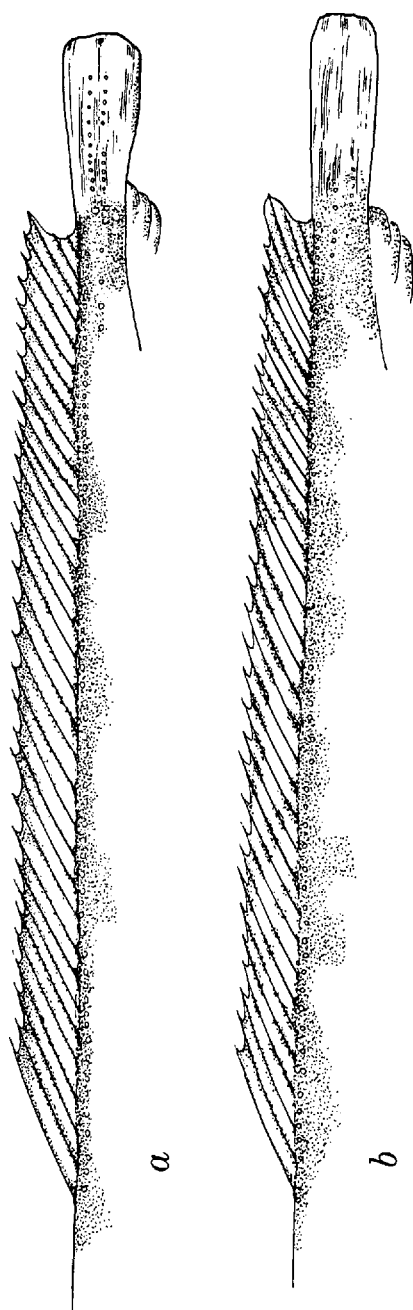


FIGURE 3. Pigmentation of dorsal fin in two species of *Porichthys*: a, *P. bathoiketes*, TABL (uncat.), 87.5 mm SL, off Nicaragua (OREGON sta. 3579); b, *P. porosissimus*, TABL (uncat.), 91 mm SL, off Panama (OREGON sta. 3588).

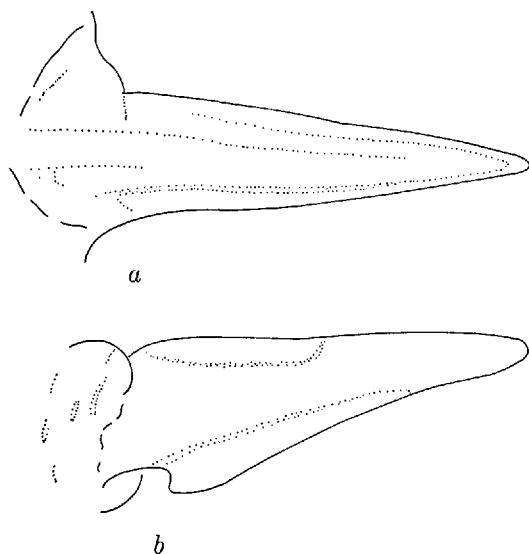


FIGURE 4. Left opercular spine in two specimens of *Porichthys pauciradiatus*: a, TU 40105, off Brazil (OREGON sta. 2088); b, UF 10275, Costa Rica.

If *Nautopaedium* should continue to be regarded as a valid genus, solely on the basis of dental characters, it would also be necessary to place the eastern Pacific *Porichthys greenei* in a separate genus. This species, which has no close relative in the western Atlantic, differs from all other mid-shipmen in having the dorsal and anal fins adnate to the caudal, a short median branch extending forward from the apex of the branchiostegal row of photophores, a rounded pectoral fin, cirri absent along the courses of the lateral lines, and in lacking minute photophores around the pores of the dorsal branch of the lateral line.

It is more difficult to speculate as to the phylogenetic relationships of the other species of *Porichthys* treated in the present paper, inasmuch as otoliths were not available for study. Two of the new species, *P. oculofrenum* and *P. kymosemeum*, seem to be rather closely related, but differ in number of gill rakers in the outer arch and number of vertebrae, in addition to color pattern. Although *P. pauciradiatus* is similar to these species in having a V-shaped branchiostegal row of photophores, a reduced number of dorsal- and anal-fin rays, and a small maximum body size, it may not be as closely related to them as first appears. *P. pauciradiatus* is unique among the western Atlantic species of *Porichthys* in usually having a spear-shaped opercular spine (Fig. 4, b), rather poorly developed teeth, a low pectoral fin-ray count, and reduced numbers of photophores in the

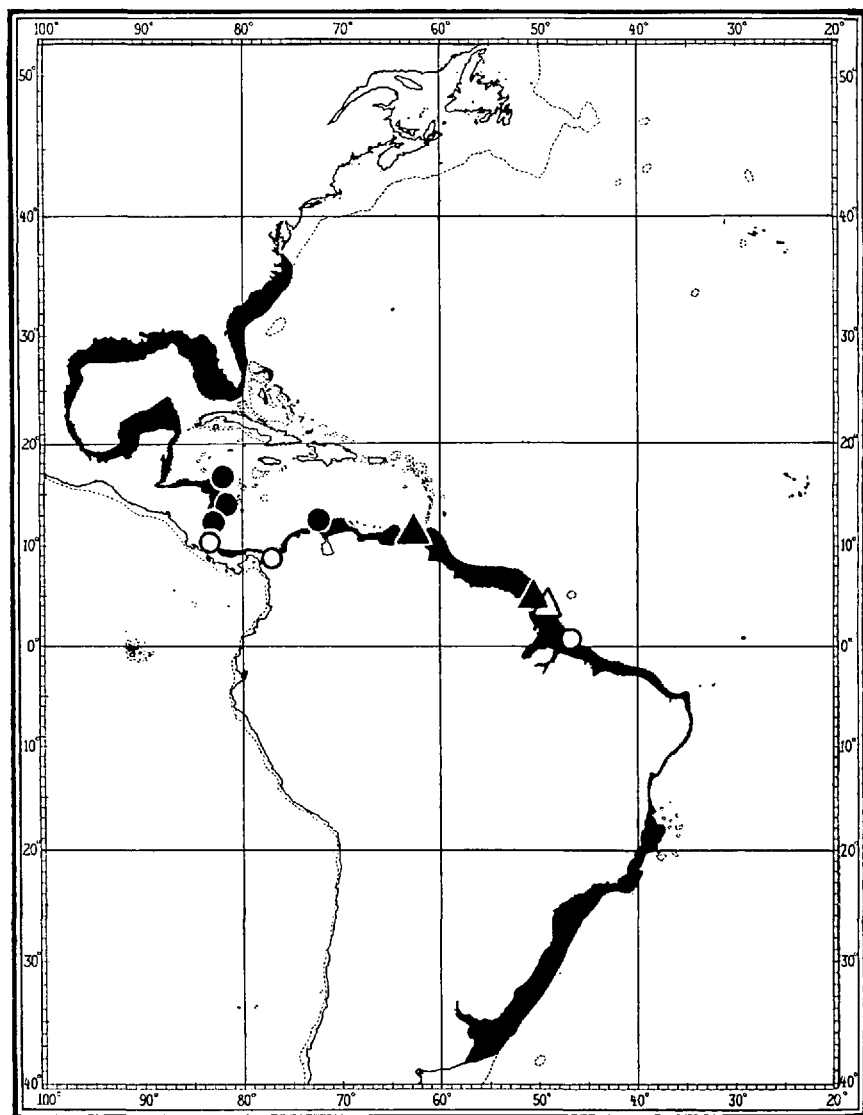


FIGURE 5. Distribution of the western Atlantic species of *Porichthys*. Dark-ened area = *P. porosissimus*; solid circles = *P. bathoiketes*; open circles = *P. pauciradiatus*; solid triangles = *P. oculofrenum*; open triangle = *P. kymoseum*.

various series (Tables 6-11). Caldwell & Caldwell (1963: 6-7) have indicated that *P. pauciradiatus* and the eastern Pacific *P. margaritatus* (*non auct.*) probably are geminate forms. No other species pairs of *Porichthys* occurring on opposite sides of Central America appear to have such close affinities.

Discovery of an apparently close relationship between *P. porosissimus* and *P. notatus* raises the question of the value of certain external morphological characters (particularly the teeth and the form of the branchiostegal photophore series) as indicators of phylogenetic relationships. *P. notatus* lacks the forwardly directed branchiostegal commissure found in *P. porosissimus*, and, in addition, has a greater number of palatine teeth, none of which is directed anteriorly. This does not necessarily mean that these characters are useless in interpreting phylogeny, since they are identical in species of obviously extremely close affinities, such as *P. porosissimus* and *P. bathoiketes*. It does indicate, however, that certain characters are subject to rather rapid evolutionary divergence and convergence, and that caution should be used in interpreting their phylogenetic significance.

Ecology.—The species of *Porichthys* occur in relatively shallow water. The greatest confirmed depth from which any specimen has been recorded is 200 fathoms (Fitch, 1964: 28), with most records coming from above 50 fathoms. The above record, which is based on the Pacific *P. notatus*, is slightly greater than for *P. bathoiketes*, the most bathyal Atlantic species, of which I have seen specimens from as deep as 175 fathoms (OREGON station 1880). Lane (1967: 6) has recorded *P. porosissimus* from 220 fathoms off the Texas coast (OREGON station 4736); however, I regard this record as questionable for several reasons: (1) Neither Lane nor I have examined the specimens on which this record was based. (2) I have seen no specimens of *P. porosissimus* from below 140 fathoms, and none from the Gulf of Mexico below 125 fathoms (only one specimen below 55 fathoms). (3) OREGON station data have occasionally been found to be in error.

Individuals of *Porichthys* often enter very shallow water, and may sometimes become stranded on beaches above the receding waves. The preferred habitat seems to be flat, open areas having a silt or mud bottom. Considering the ease and effectiveness with which collections can be made in this type of habitat, together with the numerous recent collections made in the relatively shallow waters off northern South America, it is surprising that so few individuals of certain species (*P. pauciradiatus*, *P. oculo frenum*, and *P. kymosemeum*) have been collected.

There are at least two definite instances of sympatry among the western Atlantic species of *Porichthys*: *P. porosissimus* and *P. kymosemeum* from OREGON station 2054, just north of the mouth of the Amazon River; and *P. porosissimus* and *P. oculo frenum* from OREGON station 5034, off the

Caribbean coast of Venezuela. *P. porosissimus* and *P. pauciradiatus* have also been taken at the same locality (Tortuguero, Costa Rica), though not at the same time. Considering the fact that so few specimens of *P. pauciradiatus*, *P. oculo-frenum*, and *P. kymosemeum* are known, and since these three forms, together with *P. porosissimus*, are found at comparable depths along the north coast of South America, it is possible that various combinations of these species occur together. It is also possible that *P. porosissimus* and *P. bathoiketes* occur sympatrically in the western Caribbean.

All major life-history references to the genus *Porichthys* that have so far been published deal either with the Pacific *P. notatus* (Hubbs, 1920; MacGinitie, 1935; Arora, 1948; Crane, 1965) or the Atlantic *P. porosissimus* (Lane, 1967). Although the following résumés are concerned only with these two species, one may assume that the information applies, to a large degree, to other members of the genus as well.

Spawning of *Porichthys notatus* on the central California coast takes place in late spring or early summer, with the height of reproductive activity occurring during the first half of June (Arora, 1948: 90). At this time the adults leave the deeper waters and migrate into the warmer, shallower intertidal areas. There they move under rocks or boulders partially embedded in sand or broken shell fragments and scoop out cavities by means of the pectoral fins. Spawning then occurs, with the eggs being deposited in a single layer on the roof of the cavity. The number of eggs deposited by a female varies with the size of the individual, although the total is never very great. Crane (1965: 241) recorded 126 eggs laid by one female, but did not indicate the size of the specimen. Although there is no direct evidence, it appears that the species is polygamous, since Arora (1948: 92) found egg masses in varying stages of development attached to a single rock. The females apparently leave the nest shortly after spawning, and care of the eggs is left to the male. The incubation period in *P. notatus* probably lasts from 16 to 20 days. After hatching, the embryos, which are about seven or eight millimeters long, remain fixed to the rock by means of the yolk sac, which is attached to the adhesive disc of the shell. The larvae remain this way for about a month, during which time growth takes place and the yolk gradually disappears. Finally, when the larvae are about 30 to 35 millimeters in length, the yolk sac separates and the young fish are freed. The young remain buried in the sand during the day, emerging at night to feed.

Lane (1967: 1-2), who worked on the life-history of *P. porosissimus* in the western Gulf of Mexico, has summarized his findings as follows:

Porichthys porosissimus tolerates wide ranges in temperature and salinities; however, it appears to be most common in waters where the salinity is between 20 and 30 ppt and where the temperature exceeds 25°C for at

least one season of the year. Field observations and laboratory experiments indicate a preference for mud bottoms. The fish are nocturnal, burrowing during daylight, and the time of burrowing can be changed by artificial manipulation of day-length. Periods of submergence in excess of 24 hours occur and appear to be related to a combination of cold temperature and short photoperiod or sudden cooling of the water temperature. Midshipmen are sensitive to low intensity light from at least far red to blue.

Bioluminescence appears to be used during courtship and as a warning device to predators. A poisonous opercular spine is not only painful to humans, but also can incapacitate other fish for up to half an hour. Spawning around Port Aransas, Texas, reaches peaks during spring and summer in bays, and autumn in the Gulf. Homing, for spawning, is indicated. The fish spawn when one year old at a standard length of 100-120 mm; few midshipmen reach two years of age and almost all of these are males. Females average 140 eggs,² which are up to 5 mm in diameter, with the total number of eggs being directly related to size of the individual. Young are free swimming when 12-15 mm, and most of those spawned in bays move to the Gulf between late May and September.

Atlantic midshipmen feed largely on small crustacea (Amphipods, Mysidacea) and larval to juvenile *Anchoa*. Few parasites were found on the fish examined.

As can be seen from the above, the genus *Porichthys*, as is apparently true of other batrachoidid fishes, does not have a pelagic larval stage. This, together with the fact that the species are bottom forms inhabiting relatively shallow waters and do not actively swim through long stretches of open water, probably accounts for its complete absence from insular areas, as well as its restriction to the Western Hemisphere.³

KEY TO THE WESTERN ATLANTIC SPECIES OF *Porichthys*

- 1a. Branchiostegal series of photophores with a U-shaped, forward-directed commissure at the apex (Fig. 1, a); dorsal soft rays 33 to 39, usually 33 to 36; anal rays 30 to 36, usually 31 to 34 2
- 2a. Body variously pigmented, but rarely as dark as in *P. bathoiketetes*;⁴ upper part of head and body variously spotted, but with more than five or six blotches evident (Figs. 6-12, b), except, occasionally, in larger individuals (Figs. 10, b and 11, b); pigment usually interrupted along upper halves of dorsal rays (Fig. 3, b); pectoral rays usually 17 to 19, occasionally

² Three gravid females of *Porichthys bathoiketetes* (TABL), 66.5, 71, and 79 mm SL, collected 6 June 1962, at OREGON station 3622, contained 23, 14, and 22 eggs, respectively, measuring 3.5 to 4.5 mm in diameter. A non-gravid female of *P. porosissimus* (FSBC 3374), 109 mm SL, collected 10 March 1965, in the Dry Tortugas, contained 85 eggs, measuring from 2.0 to 2.2 mm in diameter. The smallest gravid female (of 67) examined by Lane (1967:37) was 92 mm SL and contained 83 eggs.

³ Dr. C. Richard Robins informs me (personal communication) that he once saw, about 30 miles off the Pacific coast of Panama, and over an area at least 1000 fathoms deep, numerous individuals of an unidentified *Porichthys* associated with a large drift line. Judging from the unusually large size of the larval individuals of certain other species of fish, it would appear that this raft formation had been adrift for some time. Assuming that this phenomenon occurs fairly frequently, it is perhaps surprising that none of the species of *Porichthys* has succeeded in colonizing insular areas.

⁴ Lightly pigmented specimens of *P. porosissimus* have a golden belly in life, whereas in dark individuals this part of the body is black. Specimens of *P. bathoiketetes* also have a dark belly. This difference apparently is due solely to environment.

- 16; maximum size larger, the largest specimen examined 315 mm SL (Atlantic Ocean, Caribbean Sea, and Gulf of Mexico, from northern Argentina to east-central United States [southern Virginia], usually in relatively shallow water [less than 100 fathoms]) *Porichthys porosissimus* (Valenciennes)
- 2b. Entire body darkly pigmented; four, five, or six irregularly shaped dark blotches (usually taller than wide) on upper part of body, the last three or four confluent at mid-dorsum (Figs. 12, c and 13, a); pigment continuous along upper halves of dorsal rays (Fig. 3, a); pectoral rays usually 16 or 17, occasionally 15 or 18; maximum size smaller, the largest specimen examined 103 mm SL (western Caribbean, from western Venezuela to Honduras, in relatively deep water [100-175 fathoms]) *Porichthys bathoiketes*, new species
- 1b. Branchiostegal series of photophores united in a broad V, without a forward-directed commissure at the apex (Fig. 1, b); dorsal soft rays 29 to 32; anal rays 27 to 30 3
- 3a. Seven or eight well-defined saddle marks on back and head (Figs. 13, b-c and 14, a-b); no spots or kymoform (wavy) markings present on body; opercular spine often spear-shaped (Fig. 4, b); pectoral rays 14 to 16, usually 14 or 15; total gill rakers usually 8, occasionally 9 (northern Brazil to Panama and Costa Rica; in relatively shallow water [30 fathoms or less]) *Porichthys pauciradiatus* Caldwell & Caldwell
- 3b. Saddle marks either absent or, if present, not over six in number; either spots or kymoform (wavy) markings present on body; opercular spine not spear-shaped; pectoral rays 16 or 17; total gill rakers 8, 12, or 13 4
- 4a. Six fairly well-defined blotches of pigment on back and nape, coalescing so as to form saddle marks in larger specimens (Figs. 14, c and 15, a-b); numerous small spots and "worm-bore" markings present on upper part of head and anterodorsal part of back, more numerous in former region (Fig. 14, c); no kymoform (wavy) markings on dorsal third of body posterior to head; a narrow, light line connecting orbits (Fig. 14, c); no short, diagonal, dark line anterior to opercular spine; dorsal soft rays 32; anal rays 30; total gill rakers 12 or 13 (Venezuela to northern Brazil; in relatively shallow water [31-34 fathoms])
..... *Porichthys oculo frenum*, new species
- 4b. No saddle marks, blotches, spots, or "worm-bore" markings on head or back; seven kymoform (wavy) markings

present on dorsal third of body posterior to head (Fig. 15, c); no narrow, light line extending between orbits; a short, diagonal, dark line anterior to opercular spine; dorsal soft rays 29; anal rays 28; total gill rakers 8 (northern Brazil; in relatively shallow water [50 fathoms]) ----- *Porichthys kymosemum*, new species

Porichthys porosissimus (Valenciennes)

Figs. 2, a; 3, b; 5; 6-12, b

Batrachus porosissimus Valenciennes, in Cuvier & Valenciennes, 1837: 501-506 (original description; pre-Linnaean synonymy; coast of South America; dorsal fin-ray count 36, anal fin-ray count 27; genus *Batrachus* Bloch & Schneider, 1801, now placed in genus *Batrachoides* Lacépède, 1800).

Porichthys porosissimus, Girard, 1855: 141 (new combination).

Nautopaedium porosissimum, Jordan, 1919: 342 (diagnosis of new genus).

Porichthys plectrodon Goode & Bean, 1882: 236 (*nomen nudum*; Gulf of Mexico).—Jordan & Gilbert, 1882: 291 (original description; holotype, USNM 30894; type locality, Galveston, Texas; dorsal fin-ray count II-37, anal fin-ray count 34).

Material Examined.—BRAZIL: TU 18575 (4, 81-188), 55-60 fms, TU 36453 (1, 95), 50 fms, TU 36454 (2, 101-112), 25-35 fms, TU 36455 (1), 30 fms, UMML 11510 (9, 56.5-108.5), 22 fms, UF 11737 (1, 74), 15 fms, (OREGON stas. 2061, 2054, 2072, 2076, 4251, and 4247, respectively), geographic range 02°31'S, 40°51'W to 04°02'N, 50°20'W. USNM 87753 (1, 138), USNM 100882 (1, 150.5), Santos. MCZ 4633 (62, 40-66), USNM 83164 (2, 63.5-76), USNM 83168 (2, 64-70), USNM 87722 (2, 218-270), Rio de Janeiro.

BRITISH GUIANA: TU 19916 (27) and UMML 4205 (4), (31, 48-143), 28-33 fms, TU 20035 (3, 84-88.5), 37-44 fms, TU 20192 (1, 64.5), 37 fms, TU 36444 (4) and FMNH 66686 (4), (8, 53-60.5), 80 fms, TU 36445 (2, 67-76.5), 40 fms, TU 36446 (1), 43 fms, TU 36447 (8) and FMNH 66687 (5), (13, 65-102), 45 fms, TU 36448 (1), 50 fms, FMNH 66689 (6, 90.5-158), 26-27 fms, UMML 4295 (1, 92.5), 31-39 fms, (OREGON stas. 2226, 2247, 2228, 1987, 1998, 1999, 2000, 2001, 2250, and 2244, respectively), geographic range 07°55'N, 57°25'W to 09°36'N, 59°44'W.

COLOMBIA: UF 11623 (25, 58.5-160.5), 20 fms, UF 11625 (1, 88), 46 fms, UF 11629 (17, 87-181), 50 fms, UF 11630 (5, 84-136.5), 35-40 fms, UF 11631 (1, 160.5), 40-45 fms, UF 11632 (2, 98-104.5), 60-65 fms, UF 11633 (5, 84.5-176), 40-50 fms, UF 11634 (17, 79.5-108), 30 fms, UF 11635 (12, 44.5-105), 28 fms, UF 12877 (1, 93.5), 11 fms, UF 12878 (4, 61.5-123), 45 fms, UF 13011 (2, 71.5-81.5), 34 fms, UF 13013 (2, 112-151), 95 fms, UF 13014 (3, 91-129.5), 19 fms, UF 13018 (5, 65.5-132), 115 fms, UF 13019 (54, 66-105), 43 fms, UF 13366 (7,

87-175), 100 fms, TABL (uncat.) (3, 83.5-107.5), 40 fms, (OREGON stas. 4865, 4393, 4846, 4847, 4851, 4852, 4857, 4868, 4885, 5680, 5683, 5728, 5685, 5703, 5718, 5727, 4920, and 4899, respectively), geographic range 12°32'N, 71°04'W to 08°50.5'N, 76°53.5'W.

COSTA RICA: UF 11219 (1, partially mutilated), beach, ca. 2 miles south of mouth of Tortuguero Lagoons, Limon Province.

FRENCH GUIANA: TU 36450 (1), 50 fms, TU 36451 (2), 40 fms, TU 36452 (1), 37 fms, (OREGON stas. 2032, 2044, and 2046, respectively), geographic range 05°39'N, 51°56'W to 06°39'N, 52°53'W.

HONDURAS: FMNH 66685 (1, 118.5), 16°05'N, 82°05'W, 24 fms, OREGON sta. 1938. TU 36443 (6, 41-58), 16°23'N, 83°20'W, 55 fms, OREGON sta. 1864.

MEXICO: TU 10926, TU 36439 (2, 57-92), Gulf of Campeche, off Tabasco, 18°45'N, 93°20'W, 22 fms, OREGON sta. 1058. TU 36437 (2) and UF 3185 (1), (3, 107-116), Gulf of Campeche, off Campeche, 21°14'N, 91°28'W, 25 fms, OREGON sta. 1049. TU 36438 (6) and UF 4083 (2), (8, 66-89), Gulf of Campeche, off Tabasco, 18°45'N, 93°15'W, 19 fms, OREGON sta. 1057. TU 36440-36441 (11) and UF 4125 (9), (20, 73-135), Gulf of Campeche, off Tabasco, 18°43'N, 93°39'W, 35 fms, OREGON sta. 1060. TU 36474 (1, 93), Gulf of Campeche, 20°20'N, 91°55.5' W, 22 fms, OREGON sta. 419. TU 36475 (3, 89-103), Gulf of Campeche, 20°45'N, 92°12'W, 27 fms, OREGON sta. 417. UF 7103 (1, 164.5), Gulf of Mexico, beach at Mocambo, Veracruz. FMNH 45657 (4, 105-133), Gulf of Campeche, 20°18'N, 91°48'W, 20 fms, OREGON sta. 710. UMML 1801 (1, 98), Gulf of Campeche, SW of Monos Point, 6 fms. MCZ 28092 (9, 46-87), Alacran Shoals, off Yucatan. USNM 47638 (1, 65.5), Alacran Shoals, off Yucatan.

PANAMA: TU 36470 (4, 54-119), 08°22'N, 78°51'W, 6-8 fms, PELICAN sta. 223 (exact locality questioned, since above coordinates would be in Panama Bay). USNM 187847 (1, 75), Caribbean Sea, 09°12'N, 81°30'W, 135-140 fms, OREGON sta. 3585. UF 13009 (4, 65.5-84.5), 09°40'N, 79°07'W, 120 fms, OREGON sta. 5738. UF 13010 (11, 46.5-83), 09°43'N, 79°20'W, 52 fms, OREGON sta. 5739. TABL (uncat.) (9, 50-94), 09°18'N, 80°25'W, 75 fms, OREGON sta. 3587. TABL (uncat.) (2, 90-91), 09°18'N, 80°27'W, 100 fms, OREGON sta. 3588. TABL (uncat.) (4, 62-99), 09°02'N, 81°26'W, 100 fms, OREGON sta. 3595.

SURINAM: TU 19610 (1, 155), 30-33 fms, TU 19644 (2, 143-174), 6 fms, TU 19918 (1, 77), 75-80 fms, TU 36449 (3, 78-94), 50 fms, UMML 4971 (1, 76), 120-135 fms, UMML 5368 (3, 108-149.5), 33 fms, TU 36421-36422 (20), 15 fms, TU 36423 (1), 15 fms, TU 36424 (1), 16 fms, TU 36425 (1), 17 fms, TU 36426 (1), 25 fms, TU 36427 (1), 26 fms, TU 36428 (1), 30 fms, TU 36429 (11), 14 fms, TU 36430 (1), 23 fms, TU 36431 (2), 24 fms, TU 36432 (2), 24 fms, TU 36433

(3), 24 fms, TU 36434 (2, 95.5-103.5), 23 fms, TU 36435 (3), 26 fms, (OREGON stas. 2262, 2278, 2289, 2016, 2291, and 2261, respectively; and COQUETTE stas. 2, 6, 15, 20, 28, 30, 36, 144, 211, 212, 213, 214, 221, and 280, respectively), geographic range 07°18'N, 54°08'W to 07°20'N, 56°49'W.

TRINIDAD: UPR 1837 (2, 81-84), shore of Icacos Bay. MCZ 28104 (1, 58.5), between Trinidad and Grenada. UF 11637 (5) and TABL (uncat.) (2), (7, 103-168.5), 36-45 fms, UF 11638 (12) and TABL (uncat.) (6), (18, 37.5-113), 40-48 fms, UF 11639 (1, 131), 40-42 fms, UF 11641 (9) and TABL (uncat.) (5), (14, 101.5-183), 35-37 fms, UF 13367 (23, 79-159.5), 33 fms, (OREGON stas. 5024, 5025, 5031, 5030, and 5961, respectively), geographic range 11°13'N, 60°52'W to 11°08'N, 60°58'W.

ALABAMA (U. S.): TU 11633 (1, 109), 29°16'N, 88°20'W, 45 fms, OREGON sta. 1533.

FLORIDA (U. S.): MCZ 35117 (1, 110) and USNM 32801 (1), Pensacola. TU 36463 (1, 86), Gulf of Mexico, off St. Vincent Island, at West Pass, Gulf County. TU 36465 (1), UF 11587 (1, 155), and FSU 3678 (2, 133-137), Apalachicola Bay, Franklin and Gulf counties. TU 36466 (11, 95.5-133.5), Apalachicola Bay, off St. George Island, at Pilot Cove, Franklin County. FSU 9889 (25, 95-195), St. George Sound, Franklin County. USNM 73044 (3, 42-53), off Aucilla. FSBC 359 (1, 83), and FSBC 143 (6, 77.5-100), Lone Pine, Apalachicola Bay, Franklin County. USNM 73049 (1), and USNM 73045 (1, 57), Deadman Bay, Dixie County. UF 3175 (1, 76), and UF 7831 (1, 126), Gulf of Mexico, Cedar Keys, Levy County. UF 3890 (1, 105), Gulf of Mexico, 29°04'N, 83°51'W, 12 fms, OREGON sta. 907. TU 16632 (1, 39), 20 fms, TU 36456 (2, 90-122), 4-5 fms, TU 36457 (1, 86), 4 fms, (SILVER BAY stas. 54, 147, and 148 respectively). FSBC 118 (1), FSBC 974 (2, 15-23.5), FSBC 2275 (1), FSBC 2324 (1), FSBC 2563 (1, 81), 23 ft, FSBC 2582 (1), 30 ft, FSBC 2610 (1), 30 ft, FSBC 2630 (1), 30 ft, FSBC 2696 (3), 27 ft, FSBC 2714 (1), 105 ft, FSBC 3128 (2), USNM 39375-39376 (2, 66-75), Tampa Bay and vicinity, geographic range 27°39'N, 82°52'W to 28°50'N, 83°00'W. UF 9166 (15, 53-184), 8 fms, UMML 4176 (1, 150.5), 10 fms, UMML 5726 (1, 122.5), 6½ fms, USNM 133794 (1, 90), FSBC 2911 (1, 140), 120 ft, FSBC 3366 (1, 103.5), 48 ft, FSBC 3375 (1, 104.5), Gulf of Mexico, geographic range 26°17'N, 82°22'W to 27°21'N, 83°22'W. UMML 17413 (1), 45-53 fms, GERDA sta. 572. TABL (uncat.) (1, 36.5), 14 fms, TABL (uncat.) (3, 67-100), 14 fms, SILVER BAY stas. 4568 and 4636, respectively. UMML 106 (2, 94-120), UMML 776 (9, 52-132), UMML 2065 (4, 69-97), UMML 2350 (1, 98), UMML 4548 (2, 103.5-106), 10 fms, UMML 4702 (1, 143), 10 fms, UMML 5194 (1, 86.5), UMML 7777 (1, 34.5), UF 3548 (4, 55-158), UF

11657 (3, 79-109.5), USNM 116792 (2, 56-66), USNM 131296 (4, 52-68), USNM 174747 (1), TU 17873 (2, 63.5-81), FSBC 344 (9), FSBC 1601 (29), FSBC 2151 (6), 60 ft, FSBC 2434 (1), FSBC 3374 (4, 91.5-109), FSBC 3376 (1, 99.5), Gulf of Mexico, Tortugas shrimp grounds, geographic range 24°25'N, 81°46'W to 24°32'N, 82°35'W. USNM 39877 (1, 149), Cape Sable. UMML 15429 (1), UMML 15430 (1), UMML 15431 (1), UMML 15711 (1), UMML 17052 (1), UMML 17061 (2), UMML 17062 (1), UMML 17072 (2), UMML 17073 (1), Florida Bay, Everglades National Park, Flamingo, Monroe County. USNM 73040 (2, 61-102), eastern Gulf of Mexico (no further data). TABL (uncat.) (6, 42.5-95.5), 25°17'N, 80°09'W, 27 fms, SILVER BAY sta. 2354. TABL (uncat.) (1, 50.5), 25°15'N, 80°10'W, 15 fms, SILVER BAY sta. 2355. UMML 17500 (1), 25°33'N, 80°04'W, 50-55 fms, GERDA sta. 617. UMML 97 (2, 90-144), UMML 714 (1, 73), UMML 728 (1, 86), UMML 3151 (1, 112), UMML 6986 (1, 110), 6-7 fms, UMML 8569 (1, 67), UMML 9972 (1, 82.5), 50 fms, UMML 10241 (3, 69-89.5), 40 fms, Florida Keys and vicinity, from Key West to Biscayne Bay, Monroe County. UF 2347 (1, 175), Ponce de Leon Inlet, Volusia County. TU 36476 (2, 101-115), off New Smyrna Beach, Volusia County. USNM 161348 (1, 73), off Palm Beach, Broward County. TABL (uncat.) (1, 179), 19 fms, FMNH 66684 (1, 95), 64-75 fms, UF 12697 (2, 95-97), 33 fms, UF 12698 (1, 76), 33 fms, UF 12699 (1, 144), 30-32 fms, UF 12700 (1, 110), 29-30 fms, UF 12871 (3, 93.5-125), 32-34 fms, UF 14380 (1, 72), 41 fms, (SILVER BAY stas. 2682 and 2039; and OREGON stas. 5345, 5346, 5353, 5354, 5272, and 6044, respectively), geographic range 27°16'N, 80°01'W to 30°03.5'N, 80°16'W. USNM 118942 (2, 74-101), no further data.

GEORGIA (U. S.): TABL (uncat.) (1, 218), TABL (uncat.) (1, 158), near Brunswick. UF 11642 (1, 124.5), 46-65 fms, UF 14381 (1, 155), 100 fms, FMNH 64292 (1, 122), 25 fms, (SILVER BAY sta. 4912, OREGON sta. 6053, and COMBAT sta. 161), geographic range 31°00.5'N, 79°53.5'W to 31°15'N, 79°48.5'W.

LOUISIANA (U. S.): TU 2656 (1, 156), 34 fms, TU 2779 (4, 85-100), 33 fms, TU 5426 (2, 88-158), 36 fms, TU 5431 (37, 72-92), 18 fms, TU 11649 (4, 108.5-121), 30 fms, TU 11659 (1, 141), 45 fms, TU 36436 (1, 83.5), 37 fms, TABL (uncat.) (1, 100), 125 fms, TABL (uncat.) (1, 104), 24-27 fms, UF 14379 (1, 115), 50 fms, (OREGON stas. 106, 110, 614, 616, 1536, 107, 2203, 2687, and 4603, respectively), geographic range 29°27.5'N, 88°03'W to 28°00'N, 93°30'W. TU 1875 (7), TU 1906 (34), TU 4004 (29), TU 4042 (6), TU 4108 (23), TU 4188 (1), TU 4238 (17), TU 4397 (20), TU 5190 (110), TU 5213 (86, 105.5-150), TU 5253 (7), TU 5324 (91), TU 5362 (1), TU 5489 (5), TU 5497 (76), TU 5525 (30), TU 5542 (16), TU 6029 (6), TU 7104

(28, 88-170), TU 9051 (51), TU 9308 (41, 97.5-154), TU 10016 (3), TU 10031 (14, 106-173.5), all from shallow water although no specific depths recorded, from various localities (Whiskey Pass, Lake Mechant, Lake Pelto, Bayou Creole, Bayou Gerior, Bayou Hero, Bayou Grand Caillon, Bayou Taylor, and Oyster Bayou) in Terrebonne Parish. TU 6273 (1, 163), TU 8825 (6), TU 16652 (1, 114), TU 18152 (3), TU 18508 (1), TU 36459 (2), up to 25 fms, from various localities (mouth of Mississippi River, Breton Sound, South of Breton Island, Barateria Bay, and Jack Bay) in Plaquemines Parish. TU 9089 (2, 114-123), TU 9876 (12, 52-94), TU 9988 (1, 87), TU 17595 (5, 113.5-122.5), no specific depths recorded, first three series from Lake Borgne, last from Chandeleur Islands, St. Bernard Parish. TU 8957 (1, 84), TU 9321 (4), TU 9344 (2, 59-81), TU 9368 (2, 65-66), TU 9384 (3, 63-79), TU 9406 (4, 56-81), TU 9449 (1), TU 9464 (1, 79), TU 9553 (1, 70), TU 10092 (1, 91), no specific depths recorded, various localities in Lake Pontchartrain (30°09'N, 89°54'W to 30°16'N, 90°16'W), Orleans and St. Tammany parishes. TU 36464 (1), Gulf of Mexico, gulf side of Grand Isle, Jefferson Parish. UMML 1403 (1, 113.5), Gulf of Mexico, 28°53'N, 89°13'W.

MISSISSIPPI (U. S.): TU 28184 (1, 171.5), Gulf of Mexico, between Grand Isle, La., and Dauphin Island, Alabama. TU 28220 (1, 123.5), Davis Bayou, Ocean Springs, Jackson County. TU 36458 (1, 141.5), Gulf of Mexico, 30°12'N, 88°40'W, 4 fms, SILVER BAY sta. 167. USNM 133789 (1, 103), 29°14'30"N, 88°09'30"W.

NORTH CAROLINA (U. S.): USNM 111828 (1, 105), Beaufort Inlet. USNM 134267 (1, 96), Cape Lookout. USNM 83834 (1, 96), off Wilmington. TABL (uncat.) (3, 127-133), 5-6 fms, TABL (uncat.) (11, 59-129.5), 7-8 fms, TABL (uncat.) (1, 151.5), 7-8 fms, TABL (uncat.) (2, 158.5), 7-8 fms, TABL (uncat.) (1, 147), 10-11 fms, TABL (uncat.) (1, 143), 13-14 fms, TABL (uncat.) (2, 156-203), 30-31 fms, TABL (uncat.) (1, 122.5), 6-8 fms, TABL (uncat.) (1, 176), 8-10 fms, TABL (uncat.) (1, 92), 17 fms, TABL (uncat.) (1, 118), 6-6½ fms, UMML 10199 (19, 89-173.5), 90 fms, (SILVER BAY stas. 1212, 1213, 1226, 1227, 1250, 1257, 1268, 1284, 1291, 1484, 1292, and 2932, respectively), geographic range 34°03'N, 77°50'W to 34°56'N, 75°56'W.

SOUTH CAROLINA (U. S.): USNM 45751 (1, 61), 33°18'N, 77°07'W, 95 fms, ALBATROSS sta. 2417. USNM 45996 (1, 66), USNM 142832 (2, 59-87), off Charleston. TABL (uncat.) (1, 85.5), 102-105 fms, UMML 10890 (1, 112), 92-105 fms, (SILVER BAY stas. 1739 and 2541, respectively), geographic range 32°56'N, 77°47'W to 33°12'N, 77°14'W.

TEXAS (U. S.): UF 11628 (1, 133), 22 fms, TU 2652 (3, 85-108), 55 fms, TU 10633 (2, 93-94), 29 fms, TU 10991 (1, 82), 26 fms, TU 12849 (2, 96-103), 15 fms, TU 36442 (1, 78), 18 fms, TU 16250 (1,

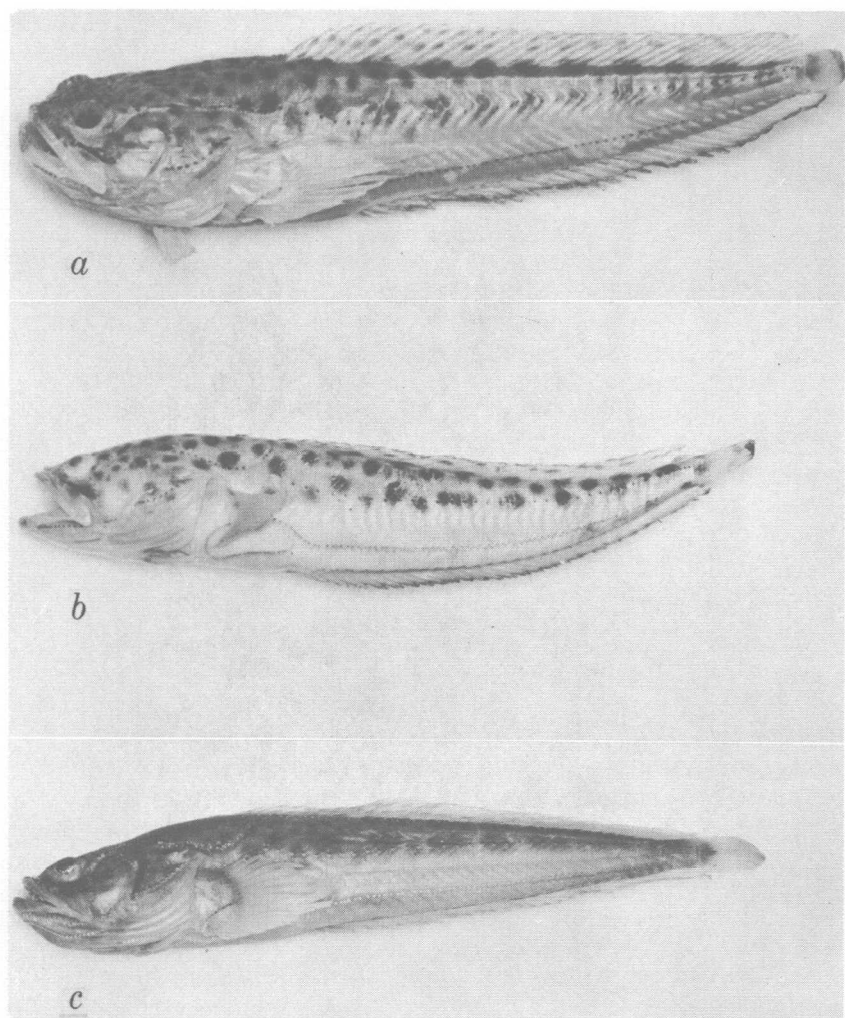


FIGURE 6. *Porichthys porosissimus* (lateral views): a, UMML 97, 90 mm SL, Florida Keys; b, UMML 4548, 106 mm SL, Tortugas shrimp grounds, Florida (10 fms); c, FSBC 143, 100 mm SL, Apalachicola Bay, Florida.

172), 27 fms, UMML 11229 (1, 71.5), 33-45 fms, (OREGON stas. 4696, 160, 1087, 1084, 1081, and 1086; and SILVER BAY stas. 8 and 293, respectively), geographic range $28^{\circ}12'N$, $94^{\circ}10'W$ to $26^{\circ}10'N$, $96^{\circ}59'W$. TU 21544 (1), bay side of west end of Galveston Island, near San Luis Pass, Galveston County. TU 36461 (3, 92-146), TU 36462 (1, 131), Aransas

and Corpus Christi passes respectively, Nueces County. ANSP 98214 (2), ANSP 98220 (1), ANSP 98225 (3), ANSP 98229 (1), ANSP 98230 (5), Port Isabel ship channel, Cameron County. USNM 94549 (1, 139), vicinity of Corpus Christi, Nueces County. USNM 126767 (2, 81-116), off Brazos and San Luis. USNM 159240 (2, 76.5-103.5), 19 fms.

VIRGINIA (U. S.): USNM 94375 (1, 195), off Cape Henry.

URUGUAY: ANSP 54056 (1, 188), Rio de la Plata. USNM 86690 (1, 288), USNM 87723 (2, 315), coast of Uruguay (no further data).

VENEZUELA: TABL (uncat.) (1, 144.5), 33 fms, UF 11626 (1, 150.5), 32 fms, UF 11627 (6, 25.5-60), 10 fms, UF 11640 (2) and TABL (uncat.) (2), (4, 94-171.5), 31-34 fms, UF 13012 (1, 127.5), 38 fms, UF 13015 (4, 60.5-89.5), 115 fms, UF 13016 (6, 81-151.5), 105 fms, UF 13017 (4, 122.5-164.5), 27 fms, (OREGON stas. 2348, 4476, 4493, 5034, 5654, 5628, 5684, and 5620, respectively), geographic range 10°29'N, 62°14'W to 11°12'N, 64°29'W. MCZ 41072 (1, 113.5), 12° 14.5'N, 70°20'W, 40 fms. MCZ 41086 (10, 58.5-163), 11°30'N, 70° 30'W.

Diagnosis.—A species of *Porichthys* characterized by a branchiostegal photophore series having a forward-directed, U-shaped commissure at its apex (Fig. 1, a); small to medium-sized brown to black spots on dorsal fin and upper part of head and body, the spots showing considerable geographic variation with regard to number and distinctness (Figs. 3, b and 6-12, b); background color of body varying from very pale to very dark; belly often golden in life; lateral-line pores with cirri; neither dorsal nor anal fin adnate to caudal; palatine teeth usually six to eight in number, enlarged, and directed forward in adults of both sexes; posterior premaxillary teeth enlarged and directed forward in most adult males; canine teeth well developed; opercular spine not spear shaped; dorsal soft rays usually 35 to 37; anal rays usually 32 to 34; pectoral rays usually 17 or 18; total vertebrae usually 44 or 45; total gill rakers usually 12 to 14; maximum body size about 315 mm SL.

Description.—Counts and proportional measurements are listed in Tables 1 through 13.

Dorsal soft rays (33) 34 to 38 (39), usually 35 to 37; anal rays (30) 31 to 35, usually 32 to 34; pectoral rays (16) 17 to 19, usually 17 or 18; total gill rakers (10) 11 to 14 (17), usually 12 to 14; total vertebrae (41) 42 to 46 (47), usually 44 or 45; mandibular photophores (21) 23 to 26 (30); branchiostegal photophores (34) 38 to 43 (47), usually 39 to 42; gular photophores (32) 37 to 42 (49), usually 39 to 41; gastric photophores (29) 33 to 38 (41), usually 35 to 37; ventral photophores (31) 36 to 41 (46); anal photophores (30) 34 to 37 (40), usually 35 to 37.

TABLE 1
SOFT DORSAL FIN-RAY COUNTS IN *Porichthys porosissimus* AND OTHER
SPECIES OF *Porichthys*

	Soft dorsal-fin rays												Total No. specimens	$\bar{x}$
	29	30	31	32	33	34	35	36	37	38	39			
Spotted ¹	—	—	—	—	—	1	16	29	19	5	—	70	36.2	
Florida Keys ²	—	—	—	—	—	2	12	32	3	—	—	49	35.7	
Campeche Gulf and Banks	—	—	—	—	—	—	4	29	12	2	—	47	36.3	
Gulf of Mexico ³	—	—	—	—	—	—	1	22	50	26	1	100	37.0	
Caribbean Sea ⁴	—	—	—	—	—	5	11	45	44	7	1	113	36.5	
Guianas to central Brazil ⁵	—	—	—	—	2	18	38	16	4	—	—	78	35.0	
Southern Brazil and Uruguay ⁶	—	—	—	—	—	—	1	4	8	—	—	13	36.5	
<i>P. porosissimus</i> ⁷	—	—	—	—	2	26	83	177	140	40	2	470	36.2	
<i>P. porosissimus</i> ⁸	—	—	—	—	4	19	6	1	—	—	—	30	34.1	
<i>P. bathoiketes</i>	—	—	—	—	2	14	30	15	—	—	—	61	35.0	
<i>P. pauciradiatus</i> ⁹	4	4	1	—	—	—	—	—	—	—	—	9	29.7	
<i>P. oculo frenum</i>	—	—	—	2	—	—	—	—	—	—	—	2	32.0	
<i>P. kymosemeum</i>	1	—	—	—	—	—	—	—	—	—	—	1	29.0	

¹ Eastern Gulf of Mexico (from Cedar Keys, Florida, south) and Atlantic coast of United States, excluding Florida Keys and Dry Tortugas.

² Including Dry Tortugas.

³ Excluding areas listed in 1 and 2 above, Gulf of Campeche and Campeche Banks.

⁴ Eastward to, and including, Trinidad.

⁵ South to ca. 04°S latitude.

⁶ Rio de Janeiro southward.

⁷ Summary of all subpopulations listed above.

⁸ Deep-water population from southwestern Caribbean.

⁹ Includes data for holotype, from Caldwell & Caldwell (1963).

Pectoral fins with faint dark spots, the lower rays slightly grayish; anal fin edged with black; upper two-thirds of dorsal fin with spots, usually in two horizontal rows running length of fin; fin spots somewhat variable in shape, number, and distribution, but those in lower row generally longer and more oblong in shape (about twice as long as those in upper row), their horizontal length equal to distance between fin rays; in some cases the fin spots are not at all confluent, whereas in extreme cases those in lower row are joined in such a way as to form a line of pigment running length of fin; spots on upper part of body encroaching slightly on lower part of dorsal fin in from nine to eleven places; caudal fin dark near base, bordered by a wide, pale area, and becoming progressively darker toward tip; dark pigment evenly distributed over most of lower jaw, in no particular pattern; underside of body and head either dusky or not, depending upon environmental conditions.

TABLE 2
ANAL FIN-RAY COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES OF
Porichthys

	Anal-fin rays										Total No. specimens	$\bar{x}$
	27	28	29	30	31	32	33	34	35			
Spotted ¹	—	—	—	—	2	9	40	15	4	70	33.1	
Florida Keys ²	—	—	—	—	2	13	34	—	—	49	32.7	
Campeche Gulf and Banks	—	—	—	—	—	6	28	13	—	47	33.2	
Gulf of Mexico ³	—	—	—	—	—	2	23	56	19	100	33.9	
Caribbean Sea ⁴	—	—	—	—	3	13	51	31	15	113	33.4	
Guianas to central Brazil ⁵	—	—	—	—	20	39	16	3	—	78	32.0	
Southern Brazil and Uruguay ⁶	—	—	—	—	1	4	3	5	—	13	32.9	
<i>P. porosissimus</i> ⁷	—	—	—	—	28	86	195	123	38	470	33.1	
<i>P. porosissimus</i> ⁸	—	—	—	6	20	4	—	—	—	30	30.9	
<i>P. bathoiketes</i>	—	—	—	—	17	30	14	—	—	61	32.0	
<i>P. pauciradiatus</i> ⁹	4	5	—	—	—	—	—	—	—	9	27.6	
<i>P. oculo frenum</i>	—	—	—	2	—	—	—	—	—	2	30.0	
<i>P. kymosemeum</i>	—	1	—	—	—	—	—	—	—	1	28.0	

¹ For explanation of superscript numbers, see Table 1.

Types.—The original description of *Batrachus porosissimus* Valenciennes contains several puzzling statements. The combination of 36 soft dorsal- and 27 anal-fin rays is found in no known species of *Porichthys*, although the separate counts occur in a number of forms. *P. porosissimus* commonly has 36 dorsal soft rays, and two (or possibly three) other species of midshipmen occurring along the north coast of South America have the above anal-ray count. In addition, it was stated in the original description that "certain individuals have five or six large transverse dark blotches on the back." While this statement conceivably could pertain to *P. porosissimus*, it applies even better to *P. oculo frenum* (described elsewhere in this paper), a species that superficially resembles *porosissimus*. Unfortunately, no mention was made regarding the shape of the diagnostic branchiostegal photophore series.

The above suggests that the original description of *P. porosissimus* was based on more than one species. Madame Marie-Louise Bauchot has kindly examined the ten syntypes of *Batrachus porosissimus* in the Museum National d'Histoire Naturelle and has supplied the following information: MNHN A. 4675, from Rio de Janeiro, collector Delalande (one specimen, in poor condition, the posterior region of the body mutilated); MNHN A. 4687, from Brazil, collectors Lesson and Garnot (one specimen, 146 mm SL, very discolored, uniformly white; dorsal soft rays 37; anal rays 34);

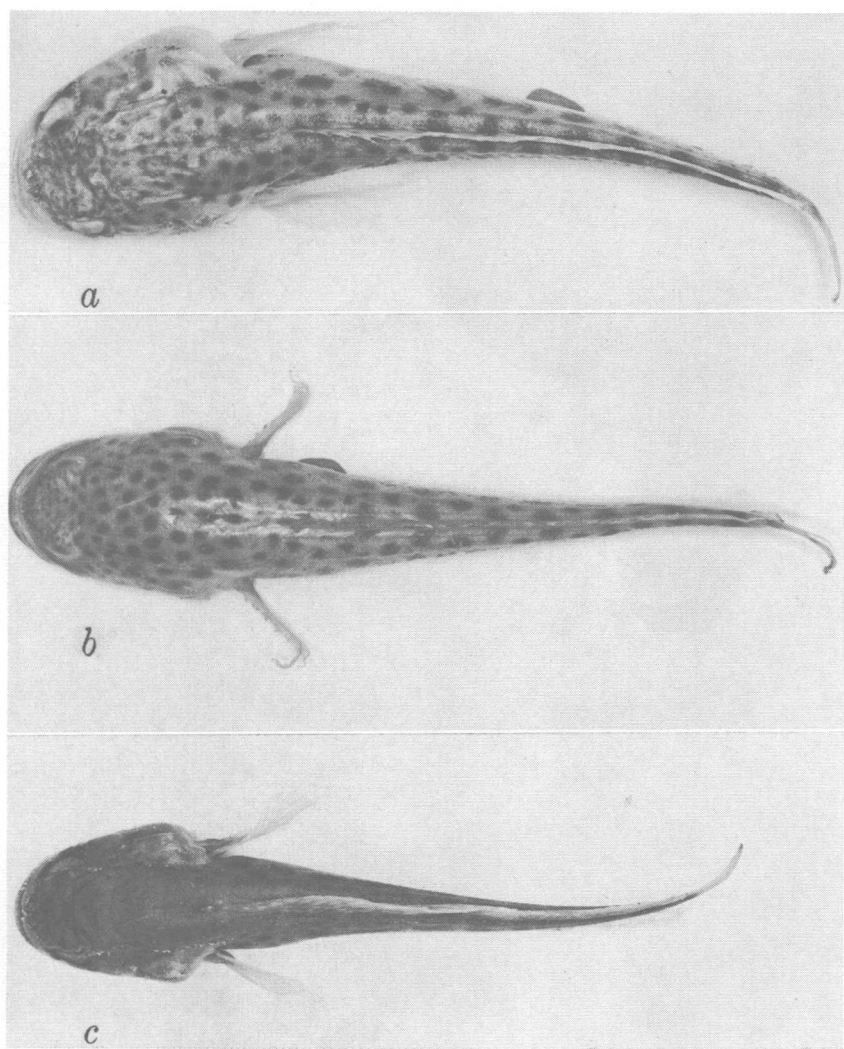


FIGURE 7. *Porichthys porosissimus* (dorsal views): a, UMML 97, 90 mm SL, Florida Keys; b, UMML 4548, 106 mm SL, Tortugas shrimp grounds, Florida (10 fms); c, FSBC 143, 100 mm SL, Apalachicola Bay, Florida.

MNHN A. 4717, from Rio de Janeiro, collector Delalande (four specimens, 71, 73, 75, and 78 mm SL; dorsal soft rays 37, 37, 37, and 37, respectively; anal rays 35, 34, 34, and 34, respectively); MNHN A. 4718, from Rio de Janeiro, collector Delalande (three specimens, 69, 71, and 82 mm SL;

TABLE 3
PECTORAL FIN-RAY COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES
OF *Porichthys**

	Pectoral-fin rays						Total No. specimens	$\bar{x}$
	14	15	16	17	18	19		
Spotted ¹	—	—	3	28	44	5	80	17.6
Florida Keys ²	—	—	5	65	16	—	86	17.1
Campeche Gulf and Banks	—	—	15	34	34	8	91	17.4
Gulf of Mexico ³	—	—	2	32	116	40	190	18.0
Caribbean Sea ⁴	—	—	3	35	86	30	154	17.9
Guianas to central Brazil ⁵	—	—	4	40	79	11	134	17.7
Southern Brazil and Uruguay ⁶	—	—	—	1	8	8	17	18.4
<i>P. porosissimus</i> ⁷	—	—	32	235	383	102	752	17.7
<i>P. porosissimus</i> ⁸	—	—	22	39	—	—	61	16.6
<i>P. bathoiketes</i>	—	1	37	70	5	—	113	16.7
<i>P. pauciradiatus</i> ⁹	11	6	1	—	—	—	18	14.4
<i>P. oculo frenum</i>	—	—	2	2	—	—	4	16.5
<i>P. kymosemeum</i>	—	—	2	—	—	—	2	16.0

* Both sides counted.

¹ For explanation of superscript numbers, see Table 1.

dorsal soft rays 37, 37, and 38, respectively; anal rays 34, 34, and 35, respectively); MNHN A. 4721, from Surinam, collectors Leschenault and Doumerc (one specimen, 132 mm SL; dorsal soft rays 33; anal rays 31). All of the above specimens have a forward-projecting U-shaped commissure at the apex of the branchiostegal photophore series. Except for the last specimen (MNHN A. 4721), all counts are near the modal values for *P. porosissimus*, and Mme. Bauchot states that the individual with the slightly atypical counts is, in all other respects, a good *porosissimus*.

The above seems to indicate that Valenciennes had but one species of *Porichthys*, and that his statements regarding anal fin-ray count and dorsal markings are in error. However, since Mme. Bauchot was unable to locate the syntypes of *P. porosissimus* (listed in the original description) from Cayenne, French Guiana (collected by a Monsieur Poiteau), it is still possible that some of the type specimens represent a second species of *Porichthys*, and that these are still extant. To firmly establish the name *porosissimus*, I therefore designate as lectotype of *Batrachus porosissimus* Valenciennes the largest (78 mm SL) of the four specimens from Rio de Janeiro, Brazil, bearing the catalog number MNHN A. 4717. The lectotype retains this catalog number, and the other three specimens from the syntypic series have been recatalogued as MNHN B. 2528. The latter specimens thus become lectoparatypes, as do the other syntypic specimens listed above.

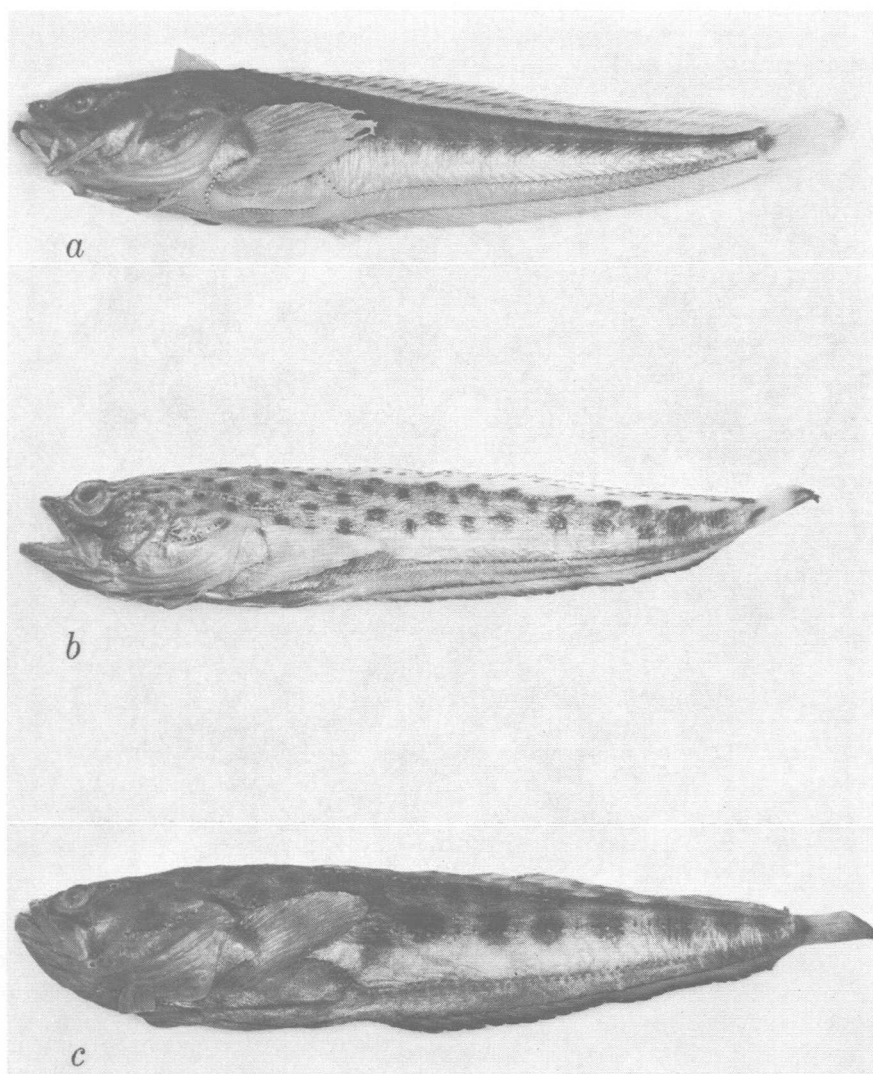


FIGURE 8. *Porichthys porosissimus* (lateral views): a, TU 9308, 114.5 mm SL (photo reversed), Bayou Grand Caillou, Louisiana; b, TU 36437, 116 mm SL (photo reversed), Gulf of Campeche, off Mexico (25 fms, OREGON sta. 1049); c, FMNH 66685, 118.5 mm SL, Caribbean Sea, off Honduras (24 fms, OREGON sta. 1938).

Variation.—*Porichthys porosissimus* exhibits considerable morphological variation throughout its range. Rather extensive variation was noted for number of vertebrae (Table 5); numbers of dorsal-, anal-, and pectoral-fin rays (Tables 1-3); and for color pattern, with the last being particularly pronounced (Figs. 6-12, b). Some variation was found for gill-raker counts and for the various photophore counts (Tables 4 and 6-11), but little or none for body proportions (Table 12).

The specimens of *Porichthys porosissimus* appearing in figures 6 through 12, b were selected so as to best demonstrate the variation one finds throughout the range of the species. It should not be assumed, however, that the specimens pictured show all the variational possibilities, nor that other individuals from the same geographic areas will necessarily be exactly identical in appearance to the above. This is particularly true with regard to the specimen from Brazil (Figs. 10, c and 11, c), which actually is atypical of *P. porosissimus* from that area, but which was pictured to show the similar pattern one can occasionally find in individuals from the south and from the eastern Gulf of Mexico and northwestern Atlantic.

Despite the extremely variable color pattern, *P. porosissimus* may be divided into two basic pigmentary types, one having a light background color, with distinct spots on the upper part of the body, and the other a dark background color, with the spots more obscure and less heavily concentrated. These two forms have well-defined ranges, with the former occurring from Cape Henry, Virginia, to the northeastern Gulf of Mexico, and the latter from the northeastern Gulf to northeastern Argentina.

A subspecific separation for *Porichthys porosissimus* receives support from several sources. Caldwell (1965) has found the area of intergradation in the Gulf of Mexico for subspecies of the sparid fish *Archosargus probatocephalus* (the eastern *probatocephalus* and the western *oviceps*) to be virtually the same as for the two forms of *P. porosissimus*. This separation is based primarily on differences in color pattern (number of bars on side of body), but is also reinforced by small, but significant, differences in lateral-line scale, gill-raker, and dorsal fin-ray counts. Dawson (1964) has shown a similar area of geographic overlap for the soleid fishes, *Gymnachirus melas* and *G. texae*, although in this case the range of the former species extends slightly farther west (to Mobile Bay). This separation is also based largely on differences in color pattern, but again finds support in certain meristic differences (numbers of caudal vertebrae, accessory sensory lines, and anal rays), a difference in maximum body length, and depth distribution. In both the above cases a direct correlation exists between geographic range and substrate, inasmuch as the extreme eastern Gulf of Mexico has a bottom that is generally harder and lighter in color (limestone, covered by a thin veneer of detrital sediments) than that of the western Gulf (sand and mud) (Lynch, 1954: 79, fig. 16) (Fig.

TABLE 4
GILL-RAKER COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES
OF *Porichthys*

	Gill rakers										Total No. specimens	$\bar{x}$
	8	9	10	11	12	13	14	15	16	17		
Spotted ¹	—	—	—	—	10	20	8	1	—	—	39	13.0
Florida Keys ²	—	—	—	1	9	21	9	1	—	—	41	13.0
Campeche Gulf and Banks	—	—	—	2	16	21	6	3	—	—	48	12.8
Gulf of Mexico ³	—	—	—	2	19	26	7	—	—	—	54	12.7
Caribbean Sea ⁴	—	—	1	6	21	28	20	8	2	—	86	13.1
Guianas to central Brazil ⁵	—	—	1	8	14	19	8	—	—	—	50	12.5
Southern Brazil and Uruguay ⁶	—	—	—	—	—	3	2	9	5	3	22	15.1
<i>P. porosissimus</i> ⁷	—	—	2	19	89	138	60	22	7	3	340	13.0
<i>P. porosissimus</i> ⁸	—	—	6	17	6	1	—	—	—	—	30	11.1
<i>P. bathoiketes</i>	—	—	—	5	27	26	3	—	—	—	61	12.4
<i>P. pauciradiatus</i>	2	2	—	—	—	—	—	—	—	—	4	8.5
<i>P. oculofernus</i>	—	—	—	—	1	1	—	—	—	—	2	12.5
<i>P. kymosemeum</i>	1	—	—	—	—	—	—	—	—	—	1	8.0

¹ For explanation of superscript numbers, see Table 1.

16). This suggests that the initial morphological differentiation likely had an environmental basis, and that ecological separation of the populations has resulted in subsequent meristic differentiation.

Since it has been shown that genetic differentiation apparently has occurred in groups of fishes having distribution patterns in the Gulf of Mexico similar to that of *Porichthys porosissimus*, it may logically be assumed that the same degree of differentiation could have occurred in the last species. In this regard, Lane (1967: 6-8) subjected specimens of *P. porosissimus* from the western Gulf of Mexico to very light background conditions, and, although the overall color of the fishes became appreciably lighter, in no case was there an exact duplication of the well-defined spotting found in individuals from the eastern Gulf and northwestern Atlantic. This would seem to indicate that genetic differences exist between the populations, and that recognition of subspecies is warranted.

In arriving at a final decision in this matter, it is necessary to (1) consider the basic factors involved, (2) compare this situation with others of a comparable nature, and (3) consider the overall pattern of variation in *Porichthys porosissimus*. Adaptation to changing background conditions occurs commonly in fishes, as a result of rapid neural and/or hormonal changes. If the change in background is permanent, the modified body pigmentation of the population may then become gradually fixed through natural selection, sometimes (in those species with short life cycles) over

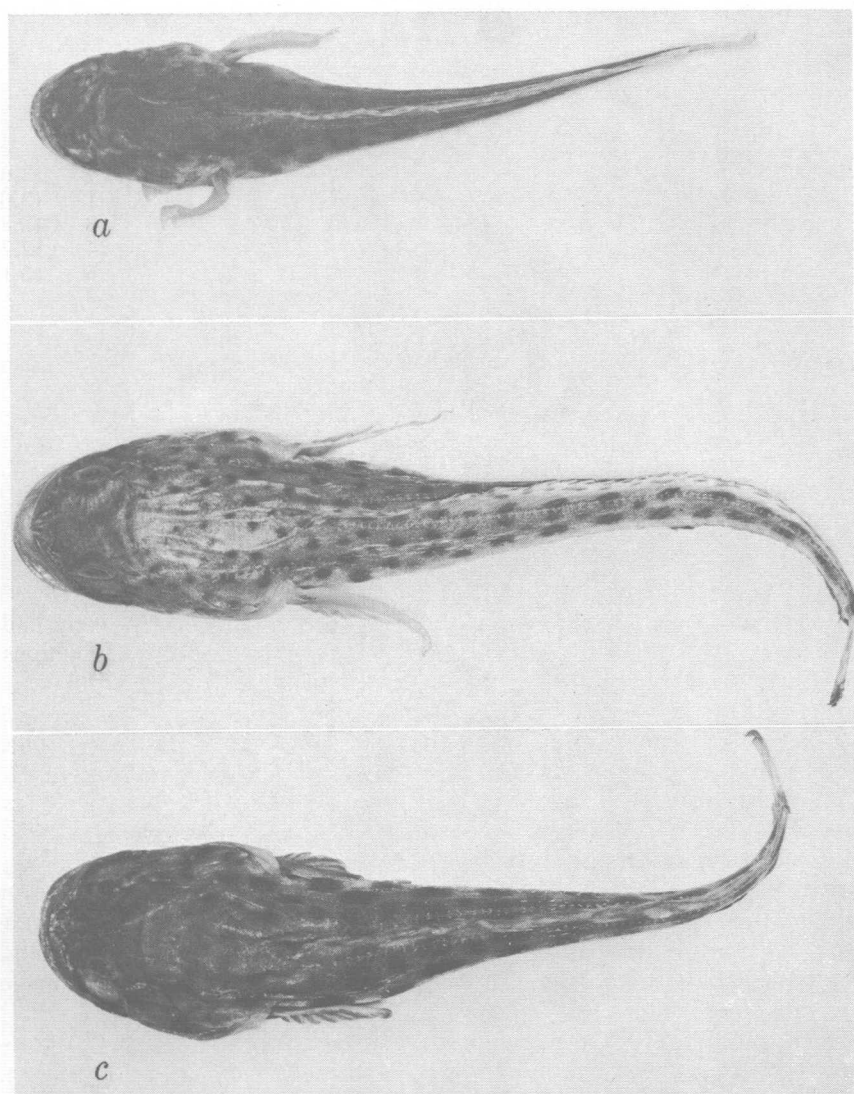


FIGURE 9. *Porichthys porosissimus* (dorsal views): a, TU 9308, 114.5 mm SL, Bayou Grand Caillou, Louisiana; b, TU 36437, 116 mm SL, Gulf of Campeche, off Mexico (25 fms, OREGON sta. 1049); c, FMNH 66685, 118.5 mm SL, Caribbean Sea, off Honduras (24 fms, OREGON sta. 1938).

TABLE 5
VERTEBRAL COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES
OF *Porichthys*

	No. of vertebrae										Total No. specimens	$\bar{x}$
	39	40	41	42	43	44	45	46	47			
Spotted ¹	—	—	—	—	3	9	10	—	—	22	44.3	
Florida Keys ²	—	—	—	—	1	19	5	—	—	25	44.2	
Campeche Gulf and Banks	—	—	—	—	1	12	5	2	—	20	44.4	
Gulf of Mexico ³	—	—	—	—	1	2	18	12	1	34	45.3	
Caribbean Sea ⁴	—	—	1	1	7	20	5	2	—	36	43.9	
Guianas to central Brazil ⁵	—	—	—	6	12	6	—	—	—	24	43.0	
Southern Brazil and Uruguay ⁶	—	—	—	—	—	2	11	4	—	17	45.1	
<i>P. porosissimus</i> ⁷	—	—	1	7	25	70	54	20	1	178	44.3	
<i>P. porosissimus</i> ⁸	—	—	3	15	8	1	—	—	—	27	42.3	
<i>P. bathoiketes</i>	—	—	—	7	14	5	—	—	—	26	42.9	
<i>P. pauciradiatus</i>	1	4	—	—	—	—	—	—	—	5	39.8	
<i>P. oculo frenum</i>	—	—	—	2	—	—	—	—	—	2	42.0	
<i>P. kymosemeum</i>	—	1	—	—	—	—	—	—	—	1	40.0	

¹ For explanation of superscript numbers, see Table 1.

a very short period of time. With the gene complement of the population thus changed, one would not expect exposure of individuals from this population to a diametrically contrasting background to produce immediately a phenotype identical to that normally found under those conditions. Such changes can only occur within the existing genetic framework of the individual. Thus, although the populations of *P. porosissimus* in the western and eastern Gulf of Mexico probably are genetically different, this, in itself, is insufficient reason for the recognition of subspecies. Other factors arguing against subspecies recognition are, first, the two basic pigmentary types are not accompanied by clear-cut, concomitant, meristic differences, such as occur in the genus *Gymnachirus* or in *Archosargus probatocephalus*; and, secondly, the variation in color pattern (within the framework of the two basic pigmentary types) in *P. porosissimus* throughout its range is quite extensive (Figs. 6-12, b) and follows no known zoogeographic pattern.

Final resolution of the above problem is based to a large extent on the presence of the spotted form of *P. porosissimus* in the Gulf of Campeche, off the coast of Yucatan. Specimens have been collected by the U. S. Fish and Wildlife Service vessel OREGON on several occasions (stations 417, 419, 710, and 1049) (Figs. 8, b and 9, b), and individuals showing less well developed, but nevertheless clearly defined, signs of spotting have been taken elsewhere in the area. It is significant that the substrate of much of the Gulf of Campeche, like that of the eastern Gulf of Mexico and off

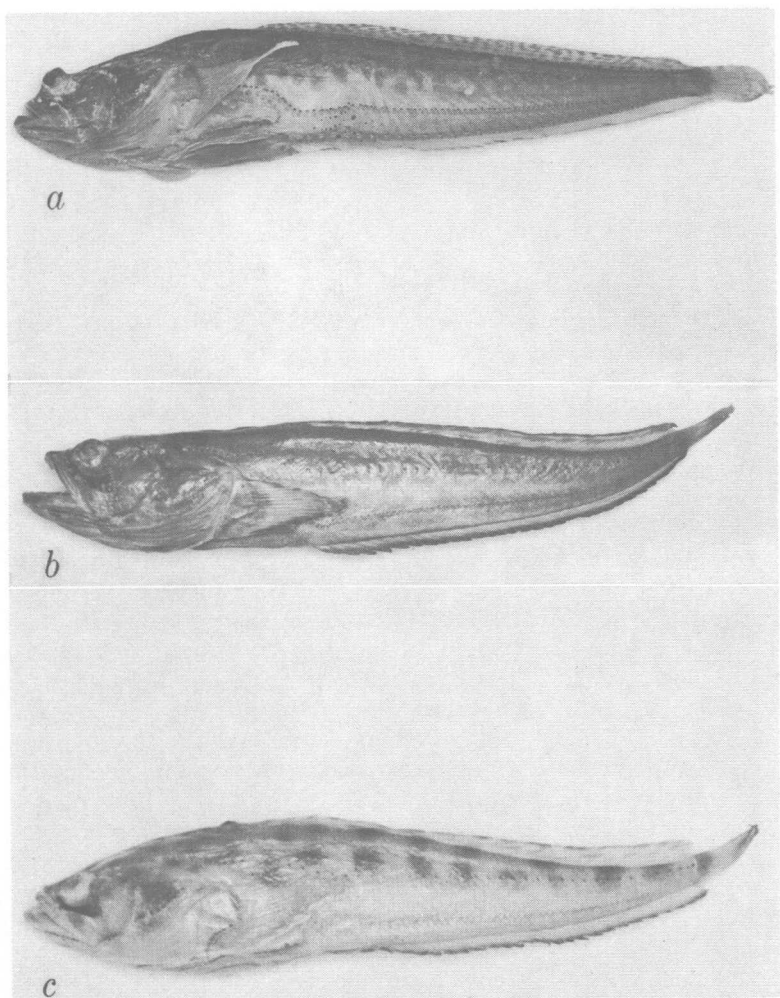


FIGURE 10. *Porichthys porosissimus* (lateral views): a, UF 13017, 122.5 mm SL, Caribbean Sea, off Venezuela (27 fms, OREGON sta. 5620); b, TABL (uncat.), 103 mm SL, Atlantic Ocean, off Trinidad (35-37 fms, OREGON sta. 5030); c, UMML 11510, 74 mm SL, Atlantic Ocean, off Brazil (22 fms, OREGON sta. 4251).

the eastern United States (and in contrast to the situation elsewhere in the western Atlantic) is generally light in color, and is basically composed of limestone (Lynch, 1954: 79, fig. 16) (Fig. 16). This similar bottom type appears to be the most logical explanation for the similarity in pig-

mentation of the populations of *P. porosissimus* from these areas. Although, strictly speaking, the spotted form of *P. porosissimus* does not occur in the more southern parts of the species' range, specimens approaching this occasionally are found (Figs. 10, c and 11, c). This is further evidence of the environmental basis of pigmentary variation in the species.

I conclude from the above that, although there is evidence that would seem to support the recognition of subspecies in *Porichthys porosissimus*, this evidence is inconclusive, and the considerable variation in both body and fin pigmentation (Figs. 6-12, b) is due basically to environmental conditions, primarily the nature of the substrate.

Porichthys porosissimus apparently reaches a larger maximum size at the southern limits of its range, inasmuch as the four largest individuals examined (270, 288, 315, and 315 mm SL) are from Uruguay and southern Brazil, even though comparatively few specimens from this area were available for study. The largest specimen seen outside of this geographic area (from off Brunswick, Georgia) was only 218 mm long.

Slightly lower dorsal, anal, and pectoral fin-ray counts were found in specimens of *P. porosissimus* from the Florida Keys (including the Dry Tortugas) than for individuals from farther north, along both the Atlantic and Gulf coasts (Tables 1-3). Unusually high fin-ray counts were found in the population occurring in the northern and northwestern Gulf of Mexico, and progressively lower counts were noted in individuals from the Campeche area, Caribbean Sea, and off northeastern South America, respectively. A slight increase in counts (particularly for the pectoral rays) was noted for individuals from southern Brazil and Uruguay. Although additional data are needed, indications are that vertebral counts follow a pattern similar to the above.

Temperature differences in the various geographic areas appear to offer a plausible explanation for the above variation, the data indicating an inverse correlation between environmental temperature and meristic features. Water temperatures in the Florida Keys, for example, average higher throughout the year than temperatures do farther north, whereas dorsal, anal, and pectoral fin-ray counts for the population from this area are distinctly lower than for populations from farther north (Tables 1-3). If these differences in fin-ray counts are indeed due solely to environmental temperature, the situation is directly opposite to that noted by Bailey & Gosline (1955: 33) for the freshwater fish family Percidae. As Carl L. Hubbs (personal communication) has noted, however, the effects of environmental temperature on meristic development in fishes are much more complex than was once thought, and contrasting effects can be found in different groups. It is also possible that the apparent relationship of temperature to fin-ray number in *P. porosissimus* is partly coincidental, since lower average temperatures, such as one finds in the northern Gulf

TABLE 6
MANDIBULAR PHOTOPHORE COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES OF *Porichthys*

	No. of photophores															Total No. specimens	$\bar{x}$
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Spotted ¹	—	—	—	—	—	—	1	7	12	14	10	3	—	—	—	47	24.7
Florida Keys ²	—	—	—	—	—	—	3	10	8	13	6	3	—	—	1	44	24.6
Campeche Gulf and Banks	—	—	—	—	—	1	4	8	12	14	6	1	—	—	—	46	24.2
Gulf of Mex- ico ³	—	—	—	—	—	2	2	11	13	12	8	2	—	—	—	50	24.3
Caribbean Sea ⁴	—	—	—	—	—	—	5	14	14	17	12	1	6	1	—	70	24.7
Guianas to cen- tral Brazil ⁵	—	—	—	—	—	1	3	10	11	16	8	1	1	—	—	51	24.4
Southern Brazil to Uruguay ⁶	—	—	—	—	—	1	—	2	6	2	4	1	1	1	—	18	24.9
<i>P. porosissimus</i> ⁷	—	—	—	—	—	5	18	62	76	88	54	12	8	2	1	326	24.5
<i>P. porosissimus</i> ⁸	—	—	—	—	—	—	1	2	14	9	2	2	1	—	—	31	24.6
<i>P. bathoiketes</i>	—	—	—	—	—	—	2	2	4	14	17	15	5	2	—	61	25.9
<i>P. pauciradiatus</i>	2	2	1	2	—	—	1	—	—	—	—	—	—	—	—	8	18.0
<i>P. oculo frenum</i>	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	2	23.5
<i>P. kymosemeum</i>	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	25.0

¹ For explanation of superscript numbers, see Table 1.

of Mexico, may merely result in a later spawning period. Thus, embryonic development may actually occur at comparable temperatures.

Photophore counts in *P. porosissimus* are much less variable than fin-ray counts. Nevertheless, some variation does occur, particularly with regard to the gular and gastric series (Tables 8-9). These counts seem to be slightly higher at the northern and southern limits of the range, and lowest in the Caribbean and off northeastern South America. In contrast to the situation involving the various fin-ray series, however, photophore counts are not highest in the population from the northern Gulf of Mexico.

Gill-raker counts do not reflect the trends found above. With the exception of a population occurring in relatively deep waters of the southwestern Caribbean (see discussion below), no marked differences were noted among populations from Virginia to central Brazil (Table 4). Individuals from southern Brazil and Uruguay, however, have somewhat higher counts. I have no explanation for this.

Although it would be desirable to have measurements from additional numbers of large specimens, indications are that bony interorbital width and snout length undergo positive allometric change, whereas proportional values for orbital diameter, opercular-spine length, caudal-peduncle depth, and pectoral-, pelvic-, and caudal-fin lengths decrease allometrically.

The most interesting population of *Porichthys porosissimus* occurs in fairly deep waters (52 to 140 fathoms) of the southwestern Caribbean, off Panama (OREGON stations 3585, 3587, 3588, 3595, 5738, and 5739). Specimens from this area have unusually dark bodies (usually dark brown), although the markings along the sides are still clearly visible (Figs. 12, a-b). These individuals seem to be somewhat smaller than usual (the largest specimen [of 31] examined being only 99 mm SL), and have vertebral and gill-raker counts; dorsal, anal, and pectoral fin-ray counts; and gular and gastric photophore counts that are significantly lower than for *P. bathoiketes* or other populations of *P. porosissimus* (Tables 1-5 and 8-9). These counts, however, are closer to those of *bathoiketes*, and this circumstance raises several questions regarding the proper taxonomic placement of these "atypical" specimens, as well as the interrelationships of *P. bathoiketes* and *P. porosissimus*. It is possible that the "atypical" specimens (1) actually are conspecific with *P. bathoiketes*, but, for some reason, have a color pattern more closely resembling that of *P. porosissimus*; (2) are specifically distinct from both *bathoiketes* and *porosissimus*; (3) represent an unusual ecotype of *P. porosissimus*, with *P. bathoiketes* merely being the extreme manifestation of this ecotype; or (4) are ecotypes of *P. porosissimus* that have acquired meristic characters similar to those of *P. bathoiketes*, which is, in turn, a valid species.

As has been indicated, the last possibility is the one favored here, with the second alternative being perhaps the next most logical choice. Although this decision is to some degree subjective, several factors have been influential: (1) The color pattern of the "atypical" individuals is essentially identical to that of *P. porosissimus*, and is distinctly different from that of *P. bathoiketes*, with no questionable specimens of the latter having yet been observed (Figs. 3, 12, and 13, a). (2) The color pattern of *P. bathoiketes* remains consistent throughout its range. (3) Typical individuals of *P. porosissimus* have been collected at lesser depths in the same geographic area where *P. bathoiketes* and the "atypical" *porosissimus* occur. (4) An 82.5-mm individual of *P. porosissimus* from off Colombia (OREGON station 5727), which was found to have counts typical of the "atypical" population (10 gill rakers, 34 soft dorsal rays, and 31 anal rays), was otherwise identical to the other specimens from this locality, which all had higher counts; furthermore, most specimens from OREGON station 4251 (off Brazil) have counts similar to those from Panama, yet in other ways are indistinguishable from typical *P. porosissimus*. (5) The females of *P. bathoiketes* are not only gravid at a much smaller size than the females of *P. porosissimus* (at least those from the western Gulf of Mexico), but the egg complement is significantly less than that calculated by Lane (1967: 39) for specimens of *P. porosissimus* of comparable size. (6) The range of *P. bathoiketes* is well defined, with no pockets of this

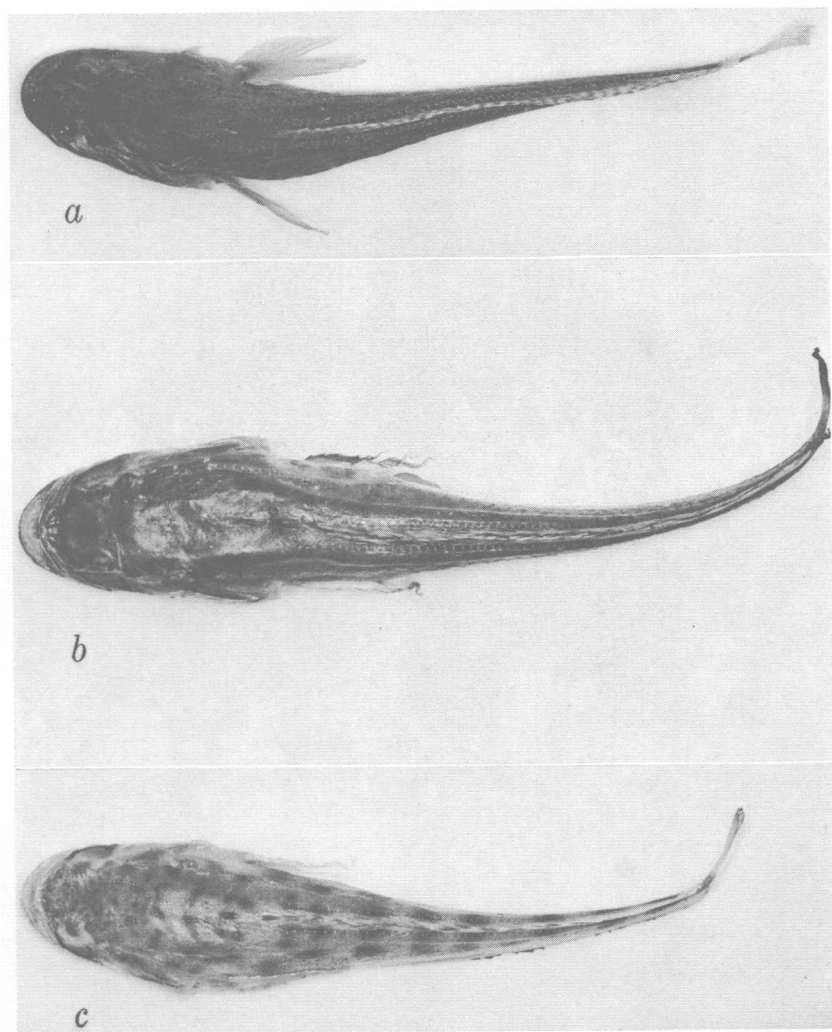


FIGURE 11. *Porichthys porosissimus* (dorsal views): a, UF 13017, 122.5 mm SL, Caribbean Sea, off Venezuela (27 fms, OREGON sta. 5620); b, TABL (un-cat.), 103 mm SL, Atlantic Ocean, off Trinidad (35-37 fms, OREGON sta. 5030); c, UMML 11510, 74 mm SL, Atlantic Ocean, off Brazil (22 fms, OREGON sta. 4251).

TABLE 7
BRANCHIOSTEGAL PHOTOPHORE COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES OF *Porichthys*

	No. of photophores																				Total No. specimens	$\bar{x}$
	<31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49		
Spotted ¹	—	—	—	—	—	—	—	1	5	9	7	5	4	6	5	3	1	—	—	—	46	41.1
Florida Keys ²	—	—	—	—	—	—	1	—	5	12	4	9	3	7	—	1	1	—	—	—	43	40.5
Campeche Gulf and Banks	—	—	—	—	—	3	—	5	5	6	7	8	5	4	1	1	1	—	—	—	46	40.0
Gulf of Mexico ³	—	—	—	—	—	—	1	1	1	5	6	12	7	4	5	2	3	—	—	—	50	41.9
Caribbean Sea ⁴	—	—	—	—	—	—	1	4	7	12	12	12	13	5	2	2	—	1	—	—	71	40.5
Guianas to central Brazil ⁵	—	—	—	—	1	1	1	4	6	8	6	6	9	6	2	1	—	—	—	—	51	40.2
Southern Brazil and Uruguay ⁶	—	—	—	—	—	—	—	2	1	2	2	2	3	2	—	1	1	—	—	—	16	40.9
<i>P. porosissimus</i> ⁷	—	—	—	—	1	4	4	17	30	54	44	54	44	34	15	11	7	4	—	—	323	40.7
<i>P. porosissimus</i> ⁸	—	—	—	—	—	—	—	3	2	6	3	7	4	4	1	1	—	—	—	—	31	40.6
<i>P. bathoiketes</i>	—	—	—	—	—	—	—	1	5	5	5	9	11	8	6	5	3	2	—	1	61	42.1
<i>P. pauciradiatus</i>	4*	3	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	30.4
<i>P. oculofernium</i>	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	35.5
<i>P. kymosemeum</i>	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	37.0

¹ For explanation of superscript numbers, see Table 1.

* One specimen of *P. pauciradiatus* had a count of 27 and three had a count of 30.

TABLE 8
GULAR PHOTOPHORE COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES OF *Porichthys*

	No. of photophores																				Total No. specimens	$\bar{x}$
	<31	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49		
Spotted ¹	—	—	—	—	—	2	—	3	2	3	11	12	8	6	—	—	—	—	—	—	47	40.4
Florida Keys ²	—	—	—	—	1	—	2	3	6	10	9	5	6	1	1	—	—	—	—	—	44	39.5
Campeche Gulf and Banks	—	—	—	—	—	1	2	2	6	3	15	7	3	4	1	—	1	1	—	—	46	40.2
Gulf of Mexico ³	—	—	—	—	1	1	1	5	4	6	7	9	7	5	1	1	—	1	—	1	50	40.4
Caribbean Sea ⁴	—	—	—	—	1	1	3	7	7	11	14	13	6	7	—	1	—	—	—	—	71	39.8
Guianas to central Brazil ⁵	—	1	—	1	3	7	10	7	10	8	2	—	—	—	—	—	—	—	—	—	49	37.8
Southern Brazil and Uruguay ⁶	—	—	—	—	—	—	—	—	—	2	4	2	3	1	1	1	—	1	—	—	15	42.7
<i>P. porosissimus</i> ⁷	—	—	1	—	4	8	15	30	32	43	66	52	32	26	4	2	3	2	1	1	322	39.8
<i>P. porosissimus</i> ⁸	—	—	—	3	1	1	9	10	3	1	2	1	—	—	—	—	—	—	—	—	31	36.7
<i>P. bathoiketes</i>	—	—	—	1	1	5	8	10	12	11	8	3	1	1	—	—	—	—	—	—	61	37.9
<i>P. pauciradiatus</i>	7*	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	27.3
<i>P. oculofernum</i>	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	2	38.5
<i>P. kymoseum</i>	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	33.0

¹ For explanation of superscript numbers, see Table 1.

* The following counts were found in seven specimens of *P. pauciradiatus*: 24, 25, 26, 27, 27, 28, and 30.

species having been found outside the area. (7) The range and depth distribution of *P. bathoiketes* is very similar to that of the bothid fish *Ancylopsetta microctenus* (Gutherz, 1966), thus suggesting that the same historical and ecological factors have resulted in evolution of these two species. Probably the most disturbing factor relating to the above is the fact that *P. bathoiketes* has not been taken sympatrically with the "atypical" *porosissimus*. This would suggest that either alternatives 1 or 3 (in the preceding paragraph) are correct. On the other hand, competition may be responsible for the mutually exclusive distributions of these two forms.

Since the "atypical" population occurs only in rather deep water, the most obvious explanation for the observed morphological features is that embryonic development occurs in a colder environment than usual. If so, however, the reduction in meristic counts is contrary to what one might expect, judging from the geographic variation previously noted for *P. porosissimus*. This would seem to suggest that these differences are not due strictly to environment, and that, despite the evidence cited above, the population actually is genetically distinct from both *P. porosissimus* and *P. bathoiketes*.

Distribution.—*Porichthys porosissimus* has been recorded, in continental waters, from Cape Henry, Virginia, to Necochea, Argentina (Fig. 5).

***Porichthys bathoiketes*, new species**

Figs. 3, a; 5; 12, c; 13, a

Porichthys porosissimus, Girard, 1855: 141 (in part; new combination).

Nautopaedium porosissimum, Jordan, 1919: 342 (in part; diagnosis of new genus).

Material Examined.—HOLOTYPE: USNM 187846 (86 mm SL), Caribbean Sea, off Nicaragua, 12°26'N, 82°26'W, 125 fms, taken in a 40-ft shrimp trawl, 23 May, 1962, OREGON sta. 3579.

PARATYPES: USNM 200607 (formerly USNM 187846) (5) and TABL (uncat.) (2), (7, 76-89), taken with the holotype. USNM 159401 (3, 81-103), off Honduras, 16°43'N, 81°34'W, 175 fms, 22 Aug., 1957, OREGON sta. 1880. TU 18573 (1, 59), off Honduras, 16°07'N, 81°05'W, 130 fms, 24 Aug., 1957, OREGON sta. 1891. TU 18574 (3) and TABL (uncat.) (1), (4, 70.5-90), off Honduras, 16°38'N, 81°39'W, 150 fms, 22 Aug., 1957, OREGON sta. 1879. TU 19928 (2, 73.5-88), off Honduras, 16°39'N, 81°43'W, 125 fms, 22 Aug., 1957, OREGON sta. 1878. TABL (uncat.) (3, 82.5-92), off Honduras, 16°00'N, 81°09'W, 120-130 fms, 6 June, 1962, OREGON sta. 3621. TABL (uncat.) (6) and UF 12965 (6), (12, 63.5-93.5), off Honduras, 16°01'N, 81°08'W, 145-150 fms, 6 June, 1962, OREGON sta. 3622. TABL (uncat.) (2, 80-88), off Honduras, 16°26'N, 81°35'W, 120 fms, 6 June, 1962, OREGON sta. 3625.

TABL (uncat.) (1), ANSP 103653 (1), FMNH 66959 (1), LACM 6986-1 (1), MCZ 45396 (1), UMML 21954 (1), UMMZ 186508 (1), (7, 70.5-102), off Honduras, 16°45'N, 81°27'W, 150 fms, 7 June, 1962, OREGON sta. 3626. UF 14382 (1, 63), off Honduras, 17°24'N, 87°56.5'W, 143 fms, 23 Jan., 1967, OREGON sta. 6403. TU 18572 (8, 72-82), off Nicaragua, 11°27'N, 83°11'W, 135 fms, 9 Sept., 1957, OREGON sta. 1902. USNM 187844 (2, 41.5-43), off Nicaragua, 14°11'N, 81°59'W, 100 fms, 21 May, 1962, OREGON sta. 3567. USNM 187845 (4) and TABL (uncat.) (2), (6, 68.5-98), off Nicaragua, 12°28'N, 82°25'W, 100 fms, 23 May, 1962, OREGON sta. 3578. TABL (uncat.) (1, 86.5), off Nicaragua, 12°28'N, 82°28'W, 110 fms, 2 June, 1962, OREGON sta. 3608. UF 11636 (1, 80.5), off Colombia, 12°09'N, 72°27'W, 100 fms, 1 June, 1964, OREGON sta. 4913.

Diagnosis.—A species of *Porichthys* characterized by a branchiostegal photophore series having a forward-directed, U-shaped commissure at its apex (Fig. 1, a); a darkly pigmented body (including belly); six medium-sized brown to black spots situated in regular sequence on upper half of body from posterior part of head to base of caudal fin; edges (outer half) of dorsal and anal fins darkly pigmented, the inner parts depigmented (Fig. 3, a); lateral-line pores with cirri; neither dorsal nor anal fins adnate to caudal; palatine teeth usually six to eight in number, enlarged, and directed forward in adults of both sexes; posterior premaxillary teeth enlarged and directed forward in most adult males; canine teeth well developed; dorsal soft rays usually 34 to 36; anal rays usually 31 to 33; pectoral rays usually 16 or 17; total gill rakers usually 12 or 13; maximum standard body length slightly over 100 mm.

Description.—Counts and proportional measurements are listed in Tables 1 through 11, and 13.

Dorsal soft rays (33) 34 to 36; anal rays 31 to 33; pectoral rays (15) 16 or 17 (18); total gill rakers (11) 12 or 13 (14); total vertebrae 42 to 44, usually 43; mandibular photophores (22) 24 to 28 (29), usually 25 to 27; branchiostegal photophores (37) 38 to 45 (49); gular photophores (33) 35 to 40 (43); gastric photophores 30 to 36 (38), usually 32 to 34; ventral photophores (34) 36 to 42 (44), usually 37 to 41; anal photophores (33) 34 to 36 (38), usually 35.

Pectoral fins darkly pigmented at base and on lower fourth of fin; inner (anterior) half of pectoral fin depigmented, with numerous melanophores lining outer halves of rays; lower (inner) half of dorsal fin depigmented, the upper (outer) half with dusky pigment along the fin rays, and with little or no pigment on the intervening membranes (Fig. 3, a); upper (inner) half of anal fin depigmented, the lower (outer) part of fin with black pigment on both the fin rays and on intervening membranes; base

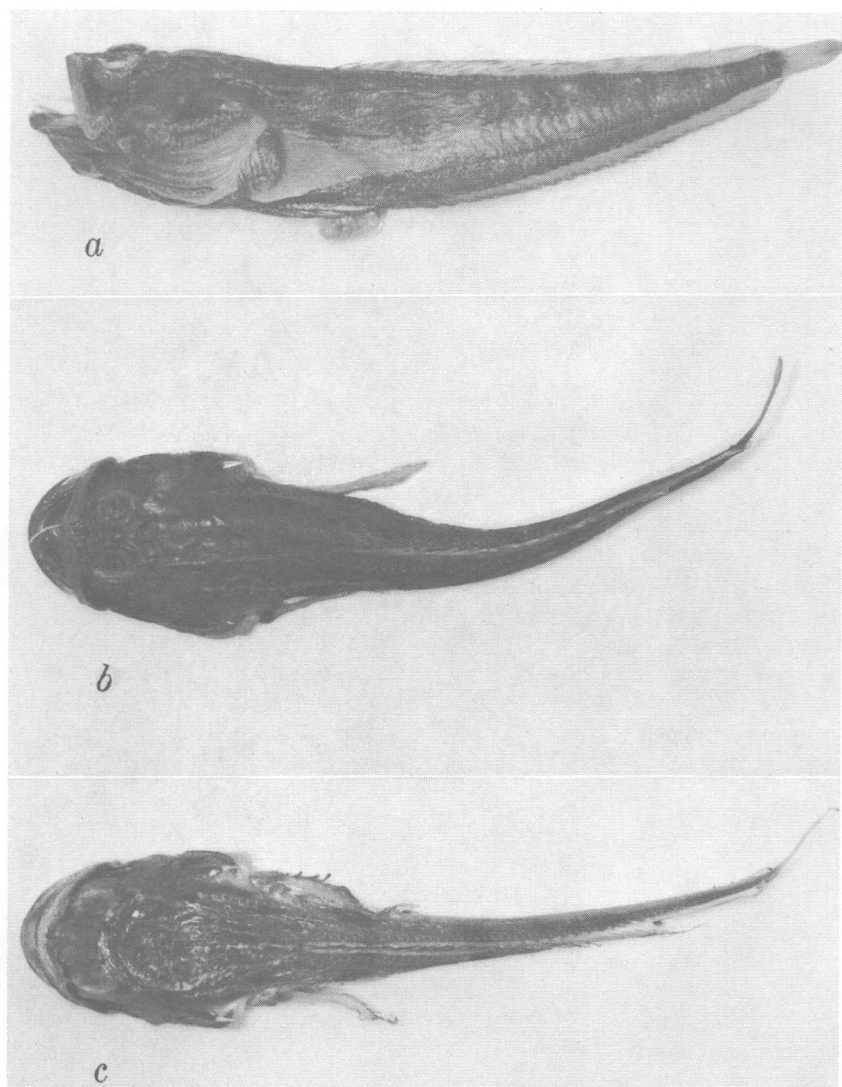


FIGURE 12. a, *Porichthys porosissimus* (deep-water form), TABL (uncat.), 91 mm SL, Caribbean Sea, off Panama (100 fms, OREGON sta. 3588); b, same as above; c, *Porichthys bathoiketes* (holotype), USNM 187846, 86 mm SL, Caribbean Sea, off Nicaragua (125 fms, OREGON sta. 3579).

TABLE 9
GASTRIC PHOTOPHORE COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES OF *Porichthys*

	No. of photophores																				Total No. specimens	$\bar{x}$	
	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41			
Spotted ¹	—	—	—	—	—	—	—	—	—	—	—	—	—	2	10	8	9	4	7	4	3	47	37.2
Florida Keys ²	—	—	—	—	—	—	—	—	—	—	—	—	4	4	6	10	8	4	6	1	1	44	36.4
Campeche Gulf and Banks	—	—	—	—	—	—	—	—	—	—	—	—	4	4	9	9	8	7	2	1	2	46	36.3
Gulf of Mexico ³	—	—	—	—	—	—	—	—	—	1	1	3	4	12	12	6	8	2	1	—	—	50	35.9
Caribbean Sea ⁴	—	—	—	—	—	—	—	—	1	8	5	7	14	14	8	9	2	—	—	—	—	68	34.3
Guianas to central Brazil ⁵	—	—	—	—	—	—	—	—	—	8	11	11	7	6	4	3	1	—	—	—	—	51	33.4
Southern Brazil and Uruguay ⁶	—	—	—	—	—	—	—	—	—	—	—	—	1	3	—	2	4	4	2	—	—	16	37.6
<i>P. porosissimus</i> ⁷	—	—	—	—	—	—	—	—	1	17	17	29	36	60	51	45	30	21	9	6	—	322	35.6
<i>P. porosissimus</i> ⁸	—	—	—	—	—	—	—	2	4	3	7	11	2	2	—	—	—	—	—	—	—	31	32.1
<i>P. bathoiketes</i>	—	—	—	—	—	—	—	—	4	5	12	15	11	6	4	3	1	—	—	—	—	61	33.3
<i>P. pauciradiatus</i>	1	2	1	1	—	1	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	8	25.6
<i>P. oculofrenum</i>	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	2	33.5
<i>P. kymosemeum</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	32.0

¹ For explanation of superscript numbers, see Table 1.

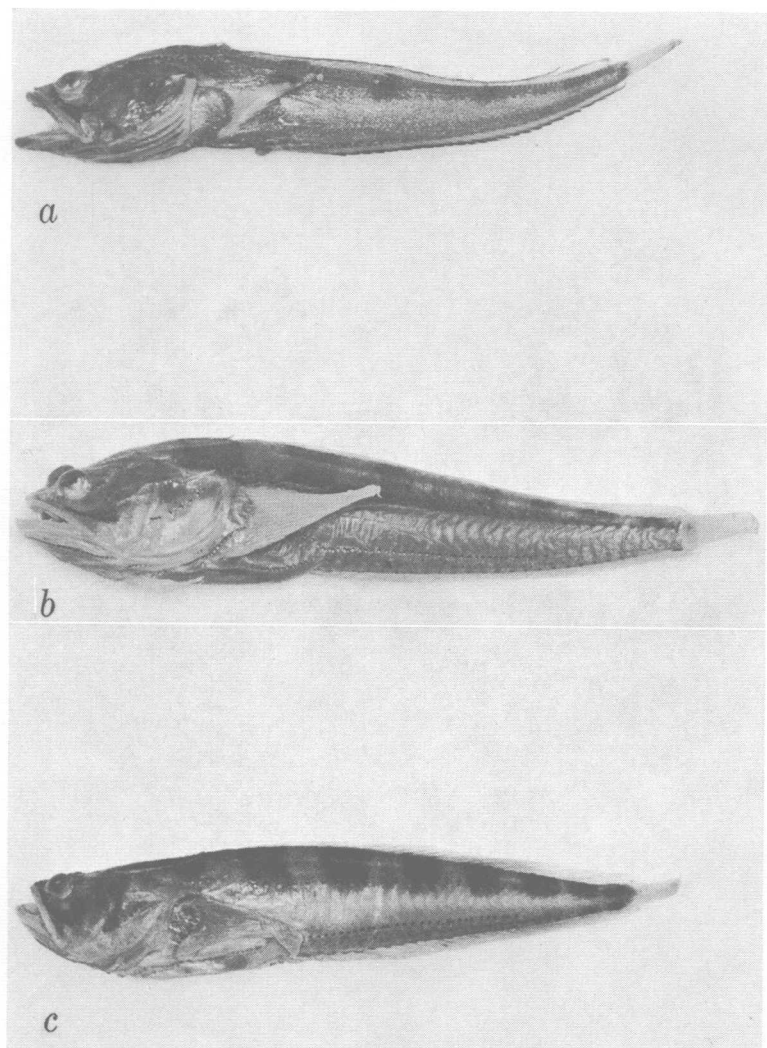


FIGURE 13. a, *Porichthys bathoiketes* (holotype), USNM 187846, 86 mm SL, Caribbean Sea, off Nicaragua (125 fms, OREGON sta. 3579); b, *Porichthys pauciradiatus*, TU 40105, 47 mm SL, Atlantic Ocean, off Brazil (30 fms, OREGON sta. 2088); c, *Porichthys pauciradiatus*, UF 10275, 65.5 mm SL, Caribbean Sea, Costa Rica (shoreline).

and tip of caudal fin dusky, with additional pigment on lower, posterior half of fin; posterior four spots on upper side of body confluent at dorsal midline, not encroaching on dorsal fin; dermis immediately surrounding spinous dorsal fin dark brown to black, darker than surrounding area; midside of body slightly lighter than above and below; dark pigment situated immediately over branchiostegal rays (on overlying tissue), thus clearly delineating each ray; largest specimen examined 103 mm SL.

Discussion.—Because of the extremely close taxonomic relationship between *P. bathoiketes* and *P. porosissimus*, as well as the extensive variation in color pattern occurring in the latter species, it was found necessary to treat the two forms concurrently. Consequently, the criteria for specific recognition of *bathoiketes* are discussed in detail in the section dealing with variation in *P. porosissimus*.

Etymology.—The name *bathoiketes* is derived from the Greek words βάθος (depth) and οἰκητής (dweller), in reference to the comparatively deep waters from which all specimens were collected. The name should be treated as a substantive.

Distribution.—*Porichthys bathoiketes* has been collected only in the southern and western Caribbean, from Colombia to Honduras, at depths of from 100 to 175 fathoms.

Porichthys pauciradiatus Caldwell & Caldwell

Figs. 4; 5; 13, b-c; 14, a-b

Porichthys pauciradiatus Caldwell & Caldwell, 1963: 1-8 (original description; holotype AHF 3037 [now LACM 20637], 33.9 mm SL; counts for holotype: dorsal rays II-29, anal rays 28, pectoral rays 14-14; type locality: Caledonia Bay, Panama).—Caldwell & Caldwell, 1964: 40 (collections by VELERO III from southern Caribbean).

Material Examined.—BRAZIL: TU 40105 (1, 47), Atlantic Ocean, 01° 10'N, 46°52'W, 30 fms, 18 Nov., 1957, OREGON sta. 2088.

COSTA RICA: UF 10275 (1, 65.5), Caribbean Sea, on beach about 1 mile south of Tortuguero Village, Limon Province, 1 Aug., 1962, coll. D. P. Kelso.

PANAMA: LACM 20638 (formerly AHF 2766) (6 paratypes, 17.7-34.5), Caribbean Sea, Caledonia Bay, 08°53'03"N, 77°41'20"W, 1-5 fms, hard sand bottom, 4 April, 1939, VELERO III sta. A 7-39.

Diagnosis.—A species of *Porichthys* characterized by a branchiostegal photophore series having a broad V-shaped apex and no forward-directed commissure (Fig. 1, b); seven or eight well-defined saddle marks on head and back, extending one-third of way down side of body (Figs. 13, b-c and 14, a-b); lateral-line pores with cirri; neither dorsal nor anal fin adnate to caudal; primary canine teeth on vomer often rather small; opercular

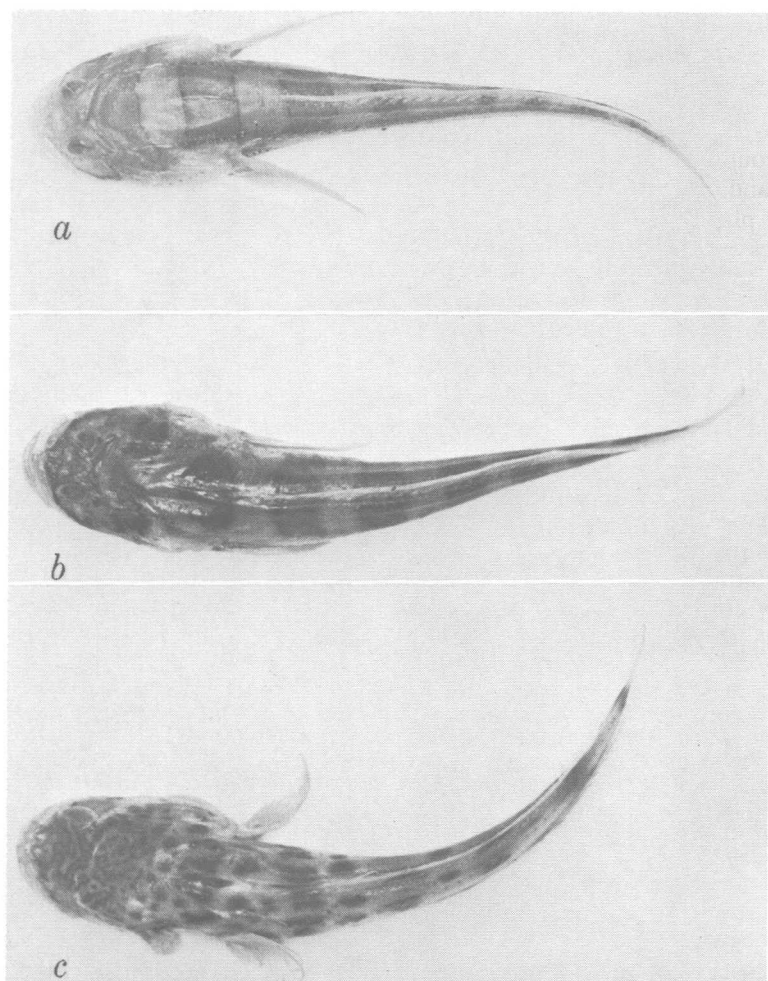


FIGURE 14. a, *Porichthys pauciradiatus*, TU 40105, 47 mm SL, Atlantic Ocean, off Brazil (30 fms, OREGON sta. 2088); b, *Porichthys pauciradiatus*, UF 10275, 65.5 mm SL, Caribbean Sea, Costa Rica (shoreline); c, *Porichthys oculo frenum* (paratype), UF 11624, 62 mm SL, Atlantic Ocean, off Brazil (32 fms, OREGON sta. 4207).

spine often spear-shaped; dorsal soft rays 29 to 31; anal rays 27 or 28; pectoral rays 14 to 16, usually 15; total gill rakers 8 or 9; total vertebrae 39 or 40; reduced numbers of photophores in all series counted (Tables 6-11); maximum body size apparently small, the largest specimen examined 65.5 mm SL.

Description.—Counts and proportional measurements are listed in Tables 1 through 11, and 13.

Mandibular photophores 16 to 22; branchiostegal photophores 27 to 33; gular photophores 24 to 31; gastric photophores 22 to 33; ventral photophores 30 to 36; anal photophores 28 to 30.

Pectoral, pelvic, dorsal, anal, and caudal fins essentially colorless; a blotch of dark pigment at pectoral base, not encroaching on fin; dark pigment on much of anterior part of both jaws, in no definite pattern; underside of body and head depigmented, except for lower third of body above anal fin, which is very slightly dusky; belly golden and side of body silvery in life (color observations by Donald P. Kelso); anteriormost saddle mark longer and more narrow than more posterior ones, extending between a point somewhat below level of opercular spine to a similar point on opposite side of head; posterior margin of second saddle mark barely encompassing the two dorsal spines; peritoneum black.

Palatine teeth very small, about 10 in number, not very evident unless fleshy covering is pushed back, present over all of bone; about six large, strong teeth on dentary (as well as numerous smaller teeth), pointing sharply inward.

Variation.—Although few specimens of *Porichthys pauciradiatus* were available for study, the following morphological differences were noted (Figs. 4, a-b; 13, b-c; 14, a-b): (1) All specimens of *P. pauciradiatus* examined from the Caribbean have a spear-shaped opercular spine, whereas in the individual from Brazil the spine is similar in shape to that found in other members of the genus. (2) The primary vomerine canine teeth in the Costa Rican specimen are less prominent than those in the individual from Brazil (Panamanian specimens were too small to analyze). (3) In the Costa Rican fish the second saddle is broader and rounder and does not extend as far down the side of the body as in the Brazilian specimen; the Panamanian specimens are more or less intermediate in this respect. (4) The fifth saddle is present in all Caribbean specimens examined, but is obsolescent in the individual from Brazil. (5) In Caribbean specimens the first saddle (situated on top of the head) is separated by a light area from the pigmented region around and behind the orbits, whereas in the Brazilian individual this light area is missing, with the saddle grading into the orbital-area pigment. (6) The saddles are not so sharply dif-

TABLE 10
VENTRAL PHOTOPHORE COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES OF *Porichthys*

	No. of photophores																Total No. specimens	$\bar{x}$	
	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45			46
Spotted ¹	—	—	—	—	—	1	3	2	7	5	15	9	2	2	1	—	—	47	39.6
Florida Keys ²	—	—	—	—	—	—	—	2	4	6	8	7	8	4	2	2	1	44	39.9
Campeche Gulf and Banks	—	—	—	—	1	2	3	5	7	3	7	9	3	5	1	—	—	46	39.4
Gulf of Mexico ³	—	—	—	—	—	2	3	9	5	11	7	7	2	3	—	—	1	50	39.1
Caribbean Sea ⁴	—	1	—	3	3	4	5	8	9	9	12	10	2	3	1	1	—	71	38.5
Guianas to central Brazil ⁵	—	—	—	—	5	7	14	4	5	3	10	1	1	1	—	—	—	51	37.3
Southern Brazil and Uruguay ⁶	—	—	—	—	—	—	5	4	6	1	—	—	—	—	—	—	—	16	37.2
<i>P. porosissimus</i> ⁷	—	1	—	3	9	16	35	36	45	40	58	44	14	16	5	2	1	325	38.8
<i>P. porosissimus</i> ⁸	—	—	—	—	—	—	1	7	9	7	5	2	—	—	—	—	—	31	38.5
<i>P. bathoiketes</i>	—	—	—	—	1	2	3	11	11	7	9	8	6	2	1	—	—	61	39.0
<i>P. pauciradiatus</i>	3	—	2	—	1	1	1	—	—	—	—	—	—	—	—	—	—	8	32.4
<i>P. oculofernum</i>	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	2	38.0
<i>P. kymosemeum</i>	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	41.0

¹ For explanation of superscript numbers, see Table 1.

TABLE 11

ANAL PHOTOPHORE COUNTS IN *Porichthys porosissimus* AND OTHER SPECIES OF *Porichthys*

	No. of photophores															Total No. specimens	$\bar{x}$
	28	29	30	31	32	33	34	35	36	37	38	39	40				
Spotted ¹	—	—	—	—	—	—	1	3	18	18	4	1	2	47	36.7		
Florida Keys ²	—	—	—	—	—	—	1	7	14	15	3	3	—	43	36.5		
Campeche Gulf and Banks	—	—	1	—	—	1	8	17	10	6	2	—	—	45	35.3		
Gulf of Mexico ³	—	—	—	—	1	—	3	14	17	11	3	1	—	50	35.9		
Caribbean Sea ⁴	—	—	1	1	2	5	9	7	16	19	7	4	—	71	35.8		
Guianas to central Brazil ⁵	—	—	—	—	—	6	8	11	21	3	—	—	1	50	35.2		
Southern Brazil and Uruguay ⁶	—	—	—	—	—	—	—	—	5	4	6	1	—	16	37.2		
<i>P. porosissimus</i> ⁷	—	—	2	1	3	12	30	59	101	76	25	10	3	322	36.0		
<i>P. porosissimus</i> ⁸	—	—	—	—	—	—	7	9	12	3	—	—	—	31	35.4		
<i>P. bathoiketes</i>	—	—	—	—	—	2	13	34	7	4	1	—	—	61	35.0		
<i>P. pauciradiatus</i>	1	4	3	—	—	—	—	—	—	—	—	—	—	8	29.3		
<i>P. oculo frenum</i>	—	—	—	—	1	1	—	—	—	—	—	—	—	2	32.5		
<i>P. kymosemeum</i>	—	—	—	—	—	—	1	—	—	—	—	—	—	1	34.0		

¹ For explanation of superscript numbers, see Table 1.

ferentiated in the individual from Costa Rica as they are in the other specimens examined.

In conclusion, although the specimens from Brazil and Costa Rica differ in a number of ways, those from Panama share certain morphological features with both. This, together with the close meristic agreement among all the specimens studied and the small number of specimens available, argues against recognition of more than one taxon.

Distribution.—*Porichthys pauciradiatus* is known from nine specimens, collected along the coasts of Costa Rica, Panama, and Brazil from shoreline to 30 fathoms.

***Porichthys oculo frenum*, new species**

Figs. 5; 14, c; 15, a-b

Material Examined.—HOLOTYPE: USNM 200606 (92.5 mm SL), Caribbean Sea, off Venezuela, 11°07'N, 62°42'W, 31-34 fms, taken in a 40-ft shrimp trawl, 23 Sept., 1964, OREGON sta. 5034.

PARATYPE: UF 11624 (1, 62), Atlantic Ocean, off Brazil, 04°46'N, 51°21'W, 32 fms, 26 Feb., 1963, OREGON sta. 4207.

Diagnosis.—A species of *Porichthys* characterized by a branchiostegal photophore series having a broad V-shaped apex and no forward-directed

TABLE 12

MEASUREMENTS OF VARIOUS SUBPOPULATIONS OF *Porichthys porosissimus*
(Proportions Expressed in Hundredths of Standard Length; All
Measurements are on Specimens from 65-127 mm SL) *

	Spotted ¹	Florida Keys ²	Campeche Gulf and Banks	Gulf of Mexico ³	Caribbean Sea ⁴	Guianas to central Brazil ⁵	Southern Brazil and Uruguay ⁶
Number of specimens	11	10	10	10	14	13	4
Pre-first dorsal length	27-31 (28.0)	27-29 (27.5)	26-28 (27.2)	26-28 (26.9)	26-31 (28.3)	27-30 (28.2)	26-28 (26.9)
Pre-second dorsal length	31-34 (32.7)	32-35 (33.2)	31-34 (32.1)	31-35 (32.3)	32-36 (33.5)	32-35 (33.6)	32-34 (32.7)
First dorsal origin to caudal base	68-75 (71.7)	65-73 (71.1)	68-76 (71.5)	64-75 (71.2)	67-73 (70.4)	64-73 (68.2)	69-74 (71.9)
Pre-pelvic length	16-19 (17.9)	16-19 (17.7)	17-19 (18.0)	15-19 (17.6)	16-20 (17.7)	17-22 (19.3)	15-17 (16.3)
Pre-anal length	38-45 (42.4)	41-44 (41.9)	40-44 (41.6)	39-46 (42.0)	39-45 (42.4)	41-46 (43.8)	38-42 (40.1)
Head length	29-30 (29.5)	28-30 (29.3)	27-32 (29.1)	26-30 (27.7)	27-30 (28.3)	27-32 (29.7)	27-28 (27.7)
Bony interorbital width	4-5 (4.7)	4-6 (4.8)	4-5 (4.3)	4-5 (4.2)	4-5 (4.4)	4-5 (4.6)	4 (4.1)
Snout length	6-7 (6.4)	6-7 (6.5)	5-6 (5.8)	5-7 (5.9)	6-7 (6.3)	6-7 (6.8)	6-7 (6.6)
Orbital diameter	5-6 (5.7)	5-6 (5.4)	5-7 (5.9)	5-6 (5.6)	6-7 (6.3)	5-7 (6.0)	6-7 (6.3)
Mouth gape	15-19 (17.8)	15-19 (17.2)	14-17 (15.6)	14-17 (15.9)	13-18 (16.0)	14-19 (16.4)	13-14 (13.5)
Lower jaw length	17-18 (17.3)	16-18 (17.1)	16-18 (16.9)	16-17 (16.7)	16-19 (17.4)	17-19 (17.8)	15-17 (15.8)
Opercular spine length	5-8 (6.4)	6-9 (6.9)	6-8 (6.7)	5-8 (6.7)	5-8 (6.5)	6-9 (7.4)	8-9 (8.1)
Caudal peduncle depth	4-5 (4.7)	4-5 (4.7)	4-5 (4.2)	4-5 (4.2)	3-5 (4.2)	4-5 (4.2)	4-5 (4.5)
Pectoral-fin length	22-28 (25.1)	21-26 (24.2)	21-25 (23.1)	23-27 (24.7)	21-28 (23.8)	23-30 (24.7)	22-28 (25.4)
Pelvic-fin length	12-14 (13.0)	12-14 (12.5)	12-14 (12.7)	13-16 (13.5)	12-15 (12.9)	12-14 (13.0)	13-15 (13.5)
Second dorsal-fin length	64-69 (67.1)	64-68 (66.6)	64-73 (67.3)	64-72 (67.4)	63-69 (65.6)	63-69 (65.5)	65-71 (66.9)
Anal-fin length	62-64 (63.3)	62-65 (63.3)	60-66 (62.6)	60-66 (62.5)	59-64 (61.5)	58-64 (61.3)	62-65 (63.2)
Caudal-fin length	13-17 (14.7)	13-17 (15.0)	14-17 (15.5)	14-16 (15.3)	13-16 (14.8)	14-17 (15.4)	—

* Under each series there is given, for each character, the range of variation, and, below, the average.

¹ For explanation of superscript numbers, see Table 1.

commissure; a narrow but well-defined depigmented area connecting the orbits dorsally; numerous spots of varying size on upper half of head and body, these spots becoming more elongate and sinuous on top of head; six large, irregularly shaped blotches on upper half of body (these coalescing so as to form saddle marks in larger specimen), the last blotch completely encircling base of caudal fin; lateral-line pores with cirri; neither dorsal nor anal fin adnate to caudal; opercular spine not spear-shaped; dorsal soft rays 32; anal rays 30; pectoral rays 16 or 17; total gill rakers 12 or 13; total vertebrae 42.

Description.—Counts and proportional measurements are listed in tables 1 through 11, and 13.

Mandibular photophores 22 to 25; branchiostegal photophores 34 to 37; gular photophores 37 to 40; gastric photophores 32 to 35; ventral photophores 38; anal photophores 32 or 33.

Outer half of pectoral fin with faint, dark, oblong spots (on larger specimen only), these spots concentrated on rays; outer margin of pelvic fin dark near base; a dark area at base of pectoral fin, the pigment partially on fin and partially on peduncle, this area somewhat variable in size and shape (much more extensive on larger specimen); bases of dorsal and anal fins pale, the outer halves darker (slightly more so on anal fin); extreme anterior part of dorsal fin noticeably darker than rest of fin; outer two-thirds of caudal fin faintly gray (in larger specimen only); large blotches on upper half of body encroaching on lower margin of dorsal fin; two moderately broad stripes, darker on margins than in center, at anterior part of lower jaw, on either side of median line; two additional smaller blotches of pigment on either side of these (in larger specimen); underside of body and head dusky; middle of side of body noticeably lighter than areas above and below; fleshy sheath surrounding dorsal spines darker than surrounding area; about three widely spaced teeth on each palatine bone, somewhat larger than other teeth, none projecting forward; total palatine teeth 11 or 12; primary canine teeth on vomer well developed, rather long, with supplementary canine teeth usually present; two teeth on either side of lower jaw (dentary bone) noticeably larger than other teeth.

Variation.—The two specimens of this species vary somewhat in color pattern, particularly with regard to pigmentation on the back and upper part of the body. In the larger individual the blotches are larger, and all are confluent at the dorsal midline (Fig. 15, a). In the smaller individual the blotches are smaller, with only the first two confluent dorsally (Figs. 14, c and 15, b). In addition, there seems to be some variation in the size and number of the smaller spots on the head and back. It will be necessary to obtain additional material to determine if this variation has a geographical basis.

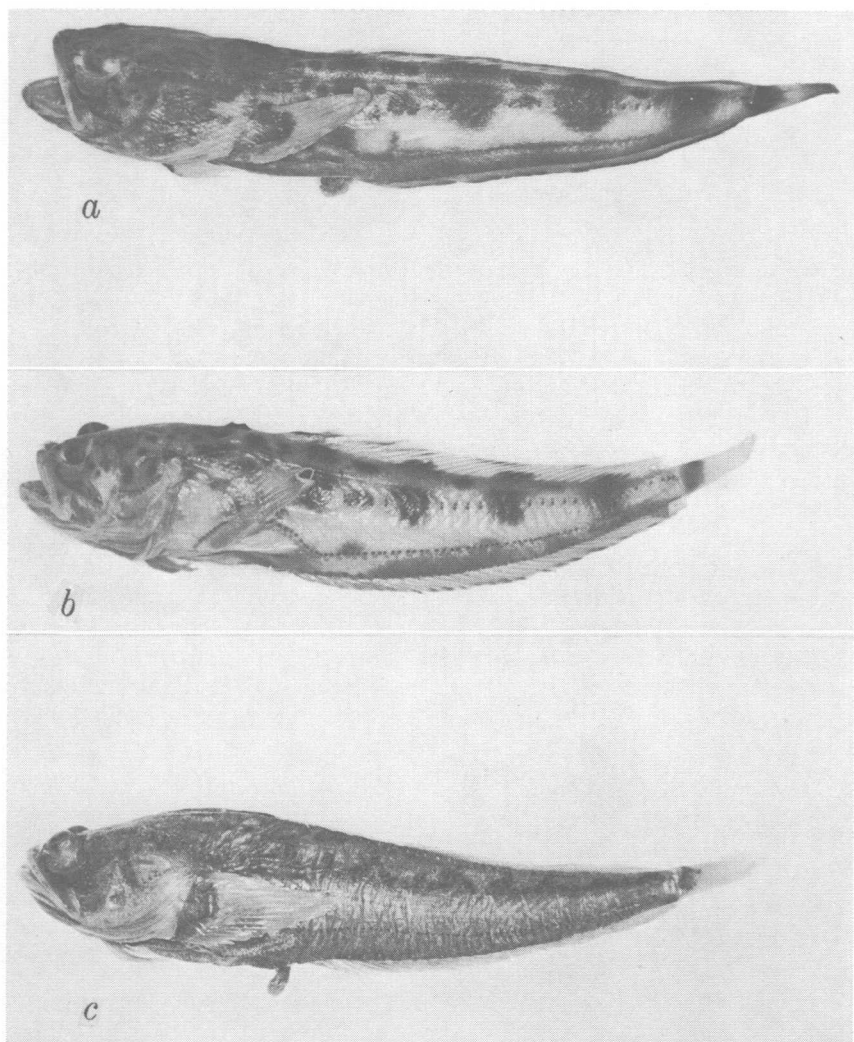


FIGURE 15. a, *Porichthys oculofrenum* (holotype), USNM 200606, 92.5 mm SL, Caribbean Sea, off Venezuela (31-34 fms, OREGON sta. 5034); b, *Porichthys oculofrenum* (paratype), UF 11624, 62 mm SL, Atlantic Ocean, off Brazil (32 fms, OREGON sta. 4207); c, *Porichthys kymosemeum* (holotype), FMNH 66688, 64.5 mm SL, Atlantic Ocean, off Brazil (50 fms, OREGON sta. 2054).

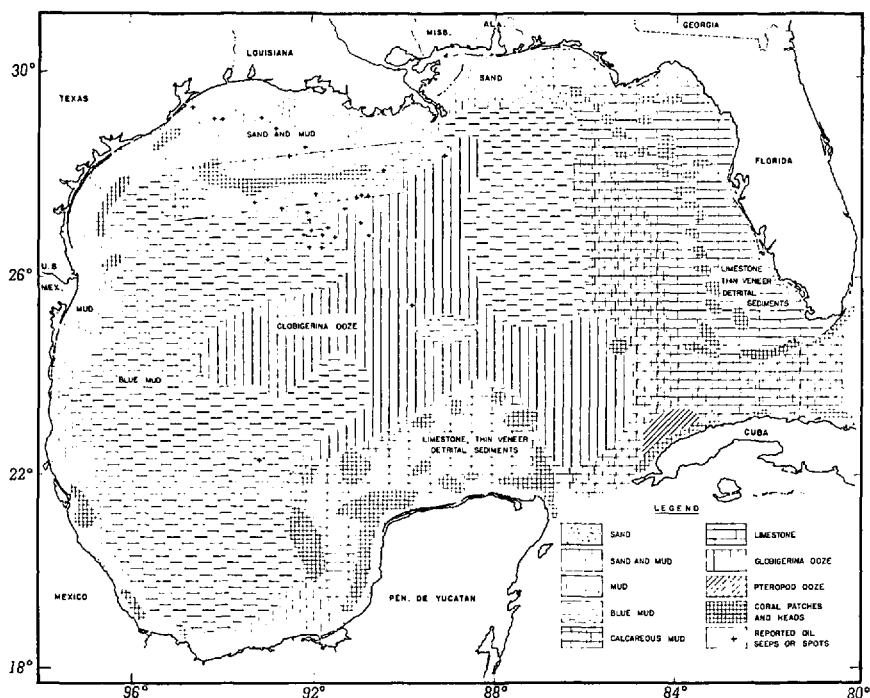


FIGURE 16. Sedimentary provinces of the Gulf of Mexico. (From Lynch, 1954: 79, fig. 16).

Discussion of Paratype Locality Data.—The OREGON station data originally accompanying the paratype of *Porichthys oculo-frenum* was found to be in error. The station given on the label (4297) is from 350 fathoms, which is far deeper than any species of *Porichthys* has yet been found. This error is further substantiated by (1) the fact that the holotype of *P. oculo-frenum* was taken at a depth of only 31-34 fathoms, and (2) the collection of a specimen of the batrachoidid fish *Thalassophryne maculosa* at station "4297." The greatest depth from which *T. maculosa* has otherwise been recorded is only 100 fathoms (Collette, 1966: 855).

A recheck of OREGON records by Mr. Richard B. Roe indicates that the station number in question almost certainly should be 4207. Nevertheless, inasmuch as some doubt will always remain with regard to this matter, the specimen of *P. oculo-frenum* from OREGON station 5034 (though in slightly poorer condition) has been designated the holotype. For the same reason, Collette (1966) did not list the above specimen of *Thalassophryne maculosa* in his paper.

Etymology.—The name *oculofrenum* is derived from the Latin words *oculo* (eye) and *frenum* (bridle), in reference to the narrow depigmented area connecting the eyes. The name should be treated as a substantive.

Distribution.—*Porichthys oculofrenum* is known from two specimens, collected off the coasts of Venezuela and Brazil at depths of from 31 to 34 fathoms.

***Porichthys kymosemeum*, new species**

Figs. 5; 15, c

Material Examined.—HOLOTYPE: FMNH 66688 (64.5 mm SL), Atlantic Ocean, off Brazil, 04°02'N, 50°20'W, 50 fms, taken in a 40-ft flat trawl, 14 Nov., 1957, OREGON sta. 2054.

Diagnosis.—A species of *Porichthys* characterized by a branchiostegal photophore series having a broad V-shaped apex and no forward-directed commissure; around seven kymoform (wavy) markings on dorsal third of body posterior to head; a short, diagonal, dark line anterior to opercular spine; dorsal soft rays 29; anal rays 28; pectoral rays 16; total gill rakers 8; total vertebrae 40; lateral-line pores with cirri; neither dorsal nor anal fin adnate to caudal; opercular spine not spear shaped.

Description.—Counts and proportional measurements are listed in tables 1 through 11, and 13.

Mandibular photophores 25; branchiostegal photophores 37; gular photophores 33; gastric photophores 36; ventral photophores 41; anal photophores 34.

No markings on pectoral fin, except for a slight amount of pigment barely encroaching at base; no pigment on dorsal or anal fins; dark pigment encircling anterior sixth of caudal fin; two faint, broad blotches of dark pigment on either side of median line on lower jaw; underside of body and head dusky; median axis of body lighter than area above and below; overall aspect of upper half of body dusky to dark; palatine teeth of uniform size, about 12 in number, not confined to front of bone; primary canine teeth on vomer well developed, with supplementary canine teeth also present; two teeth on either side of lower jaw (dentary bone), notably larger than other teeth.

Etymology.—The name *kymosemeum* is derived from the Greek words *κύμα* (wavy) and *σημείον* (sign or marking), in reference to the wavy line on the upper part of the body. The name should be treated as a substantive.

Distribution.—*Porichthys kymosemeum* is known from a single specimen, collected at a depth of 50 fathoms near the mouth of the Amazon River, off Brazil.

TABLE 13
MEASUREMENTS OF THE WESTERN ATLANTIC SPECIES OF *Porichthys*
(Proportions Expressed in Hundredths of Standard Length)*

	<i>P. kymo-</i> <i>semeum</i>	<i>P. oculo-</i> <i>frenum</i>	<i>P. pauci-</i> <i>radiatus</i>	<i>P. bath-</i> <i>oikeles</i>	<i>P. poro-</i> <i>sisissimus</i> (deep-water form)	<i>P. porosissimus</i>				
Size range (in mm)	64.5	62-92.5	47-65.5	68.5-102.5	68-99	65-127	150-170	185-218	270-315	
Number of specimens	1	2	2	22	13	72**	9	6	4	
Pre-first dorsal length	29	27-28 (27.5)	28-29 (28.8)	26-31 (28.4)	25-30 (27.7)	25-31 (27.7)	27-29 (27.8)	26-30 (28.2)	26-28 (27.0)	
Pre-second dorsal length	35	34-36 (34.9)	33-36 (34.3)	31-37 (34.1)	32-35 (33.0)	31-36 (32.9)	32-37 (33.8)	30-36 (33.1)	30-33 (32.0)	
First dorsal origin to caudal base	71	67-69 (67.6)	71 (70.7)	65-73 (69.1)	63-72 (67.5)	64-76 (70.6)	64-72 (68.4)	70-76 (71.6)	66-70 (68.5)	
Pre-pelvic length	16	19 (18.9)	15-17 (15.7)	18-24 (19.5)	17-21 (19.0)	15-22 (17.8)	17-20 (18.4)	15-20 (17.3)	15-19 (16.9)	
Pre-anal length	41	39-40 (39.6)	42-44 (42.6)	40-50 (43.9)	41-47 (44.4)	38-47 (42.3)	42-46 (43.5)	39-42 (41.2)	41-45 (43.1)	
Head length	30	29-31 (29.9)	31 (30.8)	28-33 (30.2)	28-31 (29.6)	26-32 (28.9)	29-31 (29.4)	28-30 (28.8)	27-30 (28.7)	
Bony interorbital width	3	4-5 (4.3)	3-5 (4.0)	4-5 (4.3)	4-5 (4.1)	4-6 (4.5)	5-7 (5.4)	5-7 (5.7)	6-7 (6.4)	
Snout length	6	7 (7.1)	6 (5.5)	6-7 (6.6)	5-7 (6.1)	5-7 (6.3)	5-8 (6.8)	6-8 (6.9)	7 (6.9)	
Orbital diameter	5	6 (5.8)	6-8 (6.6)	6-8 (6.7)	6-7 (6.5)	5-7 (5.9)	4-6 (5.1)	5-6 (5.1)	5 (5.0)	
Mouth gape	15	16 (15.9)	17-18 (17.3)	13-21 (16.9)	15-19 (17.1)	13-19 (16.3)	14-20 (17.8)	16-22 (19.3)	16-18 (16.7)	

TABLE 13 (CONTINUED)

	<i>P. kymo- semeum</i>	<i>P. oculo- frenum</i>	<i>P. pauci- radiatus</i>	<i>P. bath- oiketes</i>	<i>P. poro- sissimus</i> (deep-water form)	<i>P. porosissimus</i>			
Lower jaw length	18	17-19 (18.1)	17-19 (18.1)	17-20 (18.7)	17-19 (18.2)	15-19 (17.2)	16-19 (17.5)	17-20 (18.2)	16-18 (17.1)
Opercular spine length	9	7-9 (8.2)	7-8 (7.4)	5-9 (7.6)	5-8 (6.6)	5-9 (6.8)	5-7 (5.6)	4-7 (5.0)	4-5 (4.8)
Caudal peduncle depth	5	5 (5.0)	3-5 (4.0)	3-4 (3.9)	3-5 (3.9)	3-5 (4.4)	4-5 (4.0)	4 (3.8)	4 (3.9)
Pectoral-fin length	22	24-26 (25.1)	27-30 (28.5)	21-28 (24.7)	22-28 (25.0)	21-30 (24.3)	20-24 (22.3)	21-24 (22.5)	21-23 (21.6)
Pelvic-fin length	15	12-13 (12.4)	13-14 (13.7)	12-16 (13.6)	12-15 (13.9)	12-16 (12.9)	9-13 (11.9)	10-13 (11.9)	11 (11.1)
Second dorsal-fin length	64	59-60 (59.6)	68-69 (68.3)	59-66 (62.6)	62-66 (63.9)	62-73 (66.5)	61-67 (64.4)	65-71 (68.4)	63-66 (64.6)
Anal-fin length	59	57-62 (59.4)	61-64 (62.8)	56-64 (59.3)	58-64 (60.5)	58-66 (62.3)	58-63 (60.3)	59-64 (62.0)	57-63 (60.5)
Caudal-fin length	17	15-16 (15.3)	13-19 (16.3)	13-17 (15.0)	14-16 (15.1)	13-17 (15.1)	12-14 (13.2)	12-14 (12.8)	10-11 (10.8)

* Under each series there is given, for each character, the range of variation, and, below, the average.

** Caudal-fin length based on 68 specimens.

SUMARIO

PECES SAPOS DEL GENERO *Porichthys* DEL ATLANTICO OCCIDENTAL,
INCLUYENDO TRES NUEVAS ESPECIES

Los peces sapos del género *Porichthys*, comúnmente llamados guardia marinas, están confinados a áreas de fondo abierto, relativamente bajas, en aguas tropicales a templadas en ambas costas de América. Son continentales en distribución como se evidencia por el hecho de que no han sido reportados más allá de los límites de la plataforma continental, por lo menos las especies del Atlántico occidental. La mayor profundidad confirmada a la que se ha reportado su presencia es 200 brazas (Fitch, 1964: 28), siendo la mayoría de los reportes por arriba de las 50 brazas.

El género *Porichthys* es distinto por ser uno de los pocos grupos de peces de aguas someras que posee fotóforos, siendo el único caso entre los peces del Hemisferio occidental. Las filas de fotóforos están mayormente concentradas en el lado inferior de la cabeza y el cuerpo, donde forman dibujos característicos que han sido comparados con las filas de botones dorados del uniforme de un guardia marina. Springer (1957) expuso la hipótesis de que la semejanza en la disposición de los fotóforos entre los peces guardia marinas y los ctenóforos (peines gelatinosos) puede ser un ejemplo de mimetismo, pero no especuló con respecto a su posible significado. Crane (1965) demostró que la bioluminiscencia juega un papel importante durante el cortejo en *Porichthys notatus*.

Por muchos años sólo una especie de guardia marina, *Porichthys porosissimus* (Valenciennes), fue identificada en el Atlántico occidental. En 1963, Caldwell & Caldwell describieron una segunda especie, *P. pauciradiatus*, de la Bahía de Caledonia, Panamá; desde entonces, colecciones adicionales han ampliado la distribución de esta especie desde Costa Rica hasta Brasil. En este trabajo se describen tres especies adicionales: *P. bathoiketes*, que se presenta a profundidades de 100 hasta 175 brazas desde Honduras hasta Colombia; *P. oculo frenum*, se presenta de 31 a 34 brazas de profundidad frente a las costas de Venezuela y Brasil y *P. kymosemeum* en profundidades de 50 brazas cerca de la desembocadura del Río Amazonas. Excepto *P. porosissimus*, que es muy corriente en toda el área de su distribución (sur de Virginia, EE.UU., hasta el noreste de la Argentina), los ejemplares de las especies de *Porichthys* del Atlántico occidental son raras en las colecciones: de *P. bathoiketes* se conocen 61 ejemplares, de *P. pauciradiatus* nueve, de *P. oculo frenum* el holotipo y el paratipo y de *P. kymosemeum* el holotipo únicamente.

Porichthys porosissimus es una especie muy variable, tanto con respecto a la disposición del color como a los conteos merísticos. El número de radios de las aletas dorsal blanda, anal y pectoral, así como las vértebras, son mayores en latitudes más frías. Este gradiente clinal es probablemente

debido a la temperatura del ambiente, aunque ésto no ha sido definitivamente probado. El conteo de los rastrillos branquiales varía poco excepto en los límites extremos de su distribución meridional, donde son significativamente mayores. En su mayor parte las series de fotóforos muestran poca variación geográfica, aunque conteos de las series gular y gástrica parecen ser ligeramente menores en el Caribe meridional y frente a la costa noreste de Sur América.

La localización taxonómica apropiada de las poblaciones que comprenden a *P. porosissimus* (sensu lato) está sujeta a interpretaciones variables y puede resultar en el reconocimiento de una especie, con subunidades que no vale la pena nominar, hasta tanto como tres especies y cuatro formas. Yo concluyo que la variación en la disposición del color es, en la mayor parte, el resultado de influencias ambientales y que sólo dos formas deben ser reconocidas: *P. porosissimus* y la forma aquí descrita como *P. bathoiketes*.

Los caracteres que han resultado ser valiosos en la identificación e interpretación filogenética de las especies del Atlántico occidental de *Porichthys* son: la forma de la serie de fotóforos branquiostegos, disposición del color, número de radios de las aletas dorsal, anal y pectoral, número de rastrillos branquiales, de vértebras, de fotóforos, morfología de la espina opercular, naturaleza de los dientes y morfología de los otolitos.

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